The Builder.

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Honour to whom Honour.

THE TURNERS' COMPANY AND SIR HENRY BESSEMER.

THE presentation, on the 15th of April, of the freedom and livery of the Turners' Company to Sir Henry Bessemer, F.R.S., M.Inst.C.E., was no unmeaning ceremonial. It was an occasion of deep interest, as representing in some sort the relation between the representatives of one of the most powerful elements of civilisation and of technical progress in the past, and the author of one of the most wonderful revolutions in the metallurgy of the present. The Turners' Company is one of those ancient guilds with the history of which the prosperity of the City of London and the growth and progress of national welfare have been intimately connected. What may yet result from the discoveries of Sir Henry Bessemer it would be idle to attempt to predict. Our limits will only allow a brief glance at what has been already effected by his genius and perseverance.

The subject has all the more claim on our notice from the fact that the Master of the Company, who presided on the occasion, was Mr. John J. Holtzapffel, to whose valuable book on "Turning and Mechanical Manipulation" we recently called attention at some length. And the special fitness of this mode of doing civic honour to a great inventor was illustrated by an interesting personal anecdote, for the recounting of which there was, indeed, no occasion for Sir H. Bessemer to apologise. When a boy, being at his father's house in Hertfordshire, the narrator was presented by his father with one of the beautiful little 5 in. foot-lathes made by Holtzapffel, together with the book published by him in illustration of the art of turning. The boy devoted himself to the lathe with all the ardour of early genius. At that time the beautiful patterns for bank-notes which had been produced by Jacob Perkins by eccentric turning were exciting much admiration. Henry Bessemer procured specimens of this man's work, and was for some time unable to imagine how it could be produced by mechanical means. At last he came across a pattern where there was a false division, caused by some accident to the machinery. The study of this anomaly revealed to the young specialist the secret of the method of Perkins, and in three months from that time he had reproduced all the intricate patterns by simple means. It would be hard to recount a more instructive anecdote, whether as encouraging to the student on the occurrence of difficulties in his path, or as illustrating the great truth that it is in the apparent anomalies of nature that the clue to her profoundest laws is most often to be discovered.

Mr. C. Hutton Gregory, a gentleman bearing a name known to science in the second generation, and a past master of the Turners' Company, was called on by the master to make a kind of introductory address. We must refer to the daily papers for the remarks of Mr. Gregory, which are too full to admit of condensation, and which our limits do not enable us to reproduce *in extenso*. But we cannot omit some reference to the contribution made by Sir H. Bessemer himself to the Proceedings of the Institution of Civil Engineers, to which Mr. Gregory referred. Among all the valuable papers contained in that admirable series of volumes, there is not one that is of more importance. The magnitude of the revolution due to Sir Henry Bessemer may be indicated by the figures cited by Mr. Gregory. Prior to his invention, the entire quantity of cast-steel produced in England did not exceed 51,000 tons per annum, and the average cost was from 50*l.* to 60*l.* per ton. In the year 1877, the production of Bessemer steel in England alone amounted to 750,000 tons. The price averaged 10*l.* per ton; and 3,500,000 fewer tons of fuel had been used in the manufacture than would have been necessary under the old process. The total make of Bessemer steel, in that same year 1877, in the United States, Belgium, Germany, France, Sweden, and England, amounted to 1,874,278 tons. The value of the manufacturing industry of the world may thus be said to have been increased in that year, by that one invention, by the enormous sum of upwards of ninety millions sterling. To take one illustration alone of the augmentation of public wealth thus ensured, it may be remarked that the duration of the steel rails on railways (which are produced by the Bessemer process at a lower price than was paid for iron rails in the early times of the railway system) is nine times as long as that of iron rails. Out of 34,855 miles of single railway track in Great Britain, 10,194 had, some time since, been relaid with steel rails. The economy in maintenance of way thus effected is estimated by Mr. Price Williams at 1,119,301*l.* per annum,—a saving that will be trebled when these rails are everywhere laid down.

Sir Henry Bessemer's invention was preceded, as may be supposed, by a profound study on his part of the process of the manufacture of iron. That was, as justly appeared to him, essentially rude and imperfect. The blast furnace separates metallic iron from its ore, and produces a substance which is freed from a large portion of the foreign matters with which it is, in the state of ore, mingled; but still leaves it charged with minute portions of carbon, silicium, manganese, sulphur, and phosphorus, which materially deteriorate its strength and value. Thus a proportion of a one-thousandth part of sulphur produces what is called "red shortness," or makes iron unduly brittle when hot. The presence of an equally minute portion of phosphorus produces "cold shortness," or makes the metal brittle when cold. One of the most remarkable peculiarities of iron is the mode in which its physical character is affected by excessively minute admixtures of those foreign substances which so freely occur in most of its ores.

But chemical purity is not the only, nor perhaps even the first, desideratum. The old process of "puddling" iron was defective as to the mechanical structure of the metal produced. The iron at first run from the ore is crude and impure. It is either formed into "pigs," which are afterwards remelted in what is called the "finery furnace," or run directly into that receptacle, where it is subjected to blasts of air directed on its surface. By this process it is to a certain extent freed from carbon. It is then run out, and forms a flat plate, of an extremely hard and brittle nature. The mass is broken up by the hammer, in order to be again heated in the "puddling furnace."

Iron, like most metals, when on the verge of fusion loses its coherence, and readily crumbles into a sort of coarse powder. It is this property of which use is made in the process of puddling. The workman watches the state of the metal, and, at the proper moment, is able to break it into fragments by a long bar, and to spread it over the bottom of the furnace in the form of a coarse metallic sand. A large extent of surface is thus exposed to chemical action. The granulated mass swells, and emits jets of blue flame. The "puddler" continues to stir it, until the flame becomes whiter, and the metal clings together, or, as it is termed, "comes to nature." It is then rolled, by an art acquired by long practice, into balls, which are removed, as rapidly as possible, to the "squeezer." There much of the scoria and mechanically-mixed impurities is forced out, and a mass or "billet" of iron is left. This mass, however, is by no means homogeneous, or like a crystallised body formed by the cooling of a liquid. It is composed of thousands of fragments of metal, the surface of each of which is coated with either a dry oxide or a silicate of the oxide of iron. The great pressure to which the metal is subjected brings these fragments sufficiently into partial contact to cause the adhesion of the mass. But the displaced oxide or silicate remains in hollows and cavities; and thus materially weakens the coherence of the actual metal. Thus, when the squeezed billet is rolled into a "puddle bar" large cracks make their appearance at the angles, and irregular fractures are readily produced. These imperfections cannot be removed from iron formed by the puddling-furnace by any process hitherto devised.

The metallurgic character of the change that takes place by the extraction of the carbon in the puddling process is first from brittle iron to steel, then from hard to soft steel; and finally to the softest state of decarbonised iron. But this process is gone through by each granule or fragment independently, and thus when they are squeezed and rolled together there is another source of want of homogeneity in the mass. Now, iron in its malleable state is not a crystallised fluid, such as gold, silver, copper, zinc, lead or tin. It is rather a semi-metallic mechanical

mixture, imperfectly aggregated. The idea of Mr. Bessemer, in its simplest form, was that it would be possible to produce ingots of iron, or of steel, that should be as essentially metallic as ingots of the other metals. It will be seen that the theory of Mr. Edison as to the intimate constitution of metallic bodies was thus anticipated by Bessemer.

In August, 1856, a paper was read by Mr. Bessemer at the meeting of the British Association at Cheltenham, which has not been printed in the report of that body. In this were brought forward three main propositions, the truth of which has been confirmed by experiment. First, that crude pig-iron could be wholly decarbonised, while still retaining the fluid state. Second, that by the injection of atmospheric air into the fluid metal the temperature might be raised, by the combustion of the oxygen, to a degree never attained in metallurgical operations before. Third, that the fluid metal thus produced would retain its high temperature long enough to be cast into ingots, to be brought under the hammer, or to be passed through the rolls. And the period of time at which the fluid was withdrawn from the converting-vessel would determine, by the quantity of carbon that was left unconsumed in the mass, the degree of hardness or of softness of the iron or steel poured into the casting-ladle.

If an account of the objections raised to the process, or if the patient labour by which the final triumph was attained, be desired by our readers, it must be deferred to another opportunity. It became evident, in the course of manufacture, that the chemical difficulties before pointed out,—notably the presence of sulphur or of phosphorus,—opposed the command of the full advantages derived from the elegant mode of treatment substituted for the rude process of puddling. Therefore, in the first instance, pure iron from Sweden, India, or Nova Scotia was employed. The results of the trials led to the erection of steel works at Sheffield, by Messrs. Bessemer and Longsdon, for the express purpose of the commercial development of the new invention.

The results of a great number of trials made at the Royal Arsenal, Woolwich, under the superintendence of Colonel Eardley Wilmot, were as follows:—The tensile strength of the cast Bessemer iron, in its unhammered state, gave a breaking weight of 41,242 lb. to the square inch of section. If the iron was hammered or rolled, the breaking weight rose to 72,643 lb. per inch. For flat ingot rolled into boiler plate, without piling, the breaking weight gave a mean of upwards of 68,300 lb. per square inch. The breaking weight of cast unhammered steel ranged from 45,836 lb. to 68,998 lb.; and that of hammered or rolled steel from 148,324 lb. to 157,881 lb. per square inch of sectional area.

In a society of practical men, as Mr. Locke, then president of the Institution of Civil Engineers, remarked on the occasion of the paper being read by Mr. Bessemer, the narrative of the difficulties encountered by an inventor in bringing his invention into practical use is most useful. Mr. Bessemer patiently waited for two years for the full realisation of his ideas,—waited, that is to say, as to any public contradiction of the numerous attacks made on his statements,—but in waiting devoted an energy that nothing could subdue, to the vanquishing of those obstacles of detail which are so often fatal, or for a time fatal, to the progress of discovery. The great revolution which Mr. Locke foresaw from the realisation of the anticipations of Mr. Bessemer is now in full operation, and its ultimate results it would be idle to attempt to predict. Sir Henry Bessemer may almost be said to have provided the engineer with a new metal.

Presentation to a Town Surveyor.—The men in the employ of the Ramsgate Local Board met at the surveyor's office on Friday afternoon, April 16th, to present Mr. Conquest with a small testimonial of their respect and esteem. Mr. Hinds, on behalf of the men, presented the gift,—a timepiece,—with a few remarks, in which he expressed the regret they all felt for his departure from the town. The present was suitably acknowledged by Mr. Conquest, who appeared to be very agreeably surprised at such an unexpected expression of feeling on the part of the men in his department. We hear that another presentation will take place before Mr. Conquest leaves for Folkestone.

ON THE PLACE OF "HAPPY THOUGHTS" IN ART AND STUDY.

ART instruction has now for some years been sown broadcast; indeed, it is still being sown broadcast through the length and breadth of the land, and we are entitled, on the part of the defrayers of the cost, to be already looking out for, at least, the promise of a harvest, and may, perhaps, occupy ourselves with advantage meanwhile in considering upon what our chances of a harvest, immediate or more remote, may depend. M. Taine, in a lecture on art not long ago, told his pupils frankly,—"Your success depends chiefly on two things: first, that you should be gifted with genius [let us say, or talent, at least], and that may depend upon your parents,—certainly it does not on me; and, secondly, on your bestowal of pains and application; and that, again, depends, not upon me, but on yourselves." The general truth of this is not to be contested; but, nevertheless, it does not extend so far as to justify an instructor in giving up his function as a nullity. A natural endowment of great power of application will not wisely dispense with, nor can it fairly be left lacking, hints and guidance; nor is it by any means always superior to admitting the advantage of correction and encouragement. Even when willingness to "take pains,"—a condition which is so essential a complement of genius that it has sometimes, absurdly enough, been mistaken for it,—is so lively as to require no spur from extraneous incitement, it may reach the wished-for goal all the sooner, and more certainly, for timely obligation to a warning touch of the right rein.

It is probably in consequence of what we may almost call the universality of instruction in art at present, that instructors are likely to insist too exclusively, and with exaggerated emphasis, upon the meritoriousness and absolute efficiency of sustained plodding labour. Experience tells them that only by enforcing such labour can any presentable result be obtained in a vast multitude of cases when a crowd of students, independently of selection, are set down before either books or drawing-boards. The result in the majority of cases under these conditions may possibly be worked up to the tolerable; but even so, scarcely to more than to Dogberry's standard of "very tolerable and not to be endured." The consequence, however, upon the superiorly-gifted few is likely to be lamentable enough. Conscientious youth obeys injunctions and venerates authority in blind obedience, and when the docility of sex is added to that which is natural to early years, the veneration and the obedience will be still further intensified. No more is needed, then, but the fortuitous concurrence of self-sufficiency and whim in the instructor to condemn fair natural talent to a persistance in drudgery, which deadens all vivacity and reduces what should be vital to the exercise of merely mechanical energy. It is an unhappy, but by no means unusual, form of egotism in a teacher to assume that his relation to particular pupils is destined to continue that of a teacher for all time; only to such a disposition can it be due that students have been detained month after month at a stage of instruction which it is certain that they can never fully master until they have been urged over its edge to an adventurous attempt upon the next beyond. It is, perhaps, possible that the entire mystery of all the subtleties of line and gradations of colour in a twig of the horse-chestnut bursting into leaf may be absolutely infinite; but human life is finite, and infinite mysteries still more recondite are pressing for attention. Let the teacher recognise that fact, and not mistake pedagogic pedantry for enthusiasm and for truth. Certain it is that murmurs are heard about the world, and occasionally a louder outcry from some who look back regretfully at valuable years,—yes, even years,—wasted in ill-applied work imposed by authority too dignified to be questioned, or voluntarily pursued under the influence of delicious eloquence, which lulled to sleep all better impulses of intelligence and protest. The rudiments of design have much the same relation to original composition as the elements of grammar to the power of conversing in a new language. Words are in themselves simpler than phrases, and phrases than propositions; but the study of individual words to be built up afterwards into phrases, and of phrases separately which are to be mastered completely before they are linked together into sentences,—this is a process for the adult which the achievements of any child in a nursery will put to shame. The child learns its words as parts of phrases, its phrases as parts of sentences, and all in direct reference to meanings which it has the highest interest and intensest curiosity to become acquainted with. Wiser adults who would master a new language,—such was the way of Lord Macaulay,—make themselves as little children. They start with an eager interest in the knowledge to be obtained, encourage and foster it by applying direct to some work which engages interest and invites attention, and pick and pick out meanings, connexions, constructions, by help of a literal translation, and then complete the analytical process by a synthetical, by assiduously committing to memory all the grammatical forms that are required to give to knowledge precision and completeness. The course and the conditions of study in art must be much the same if the best results are to ensue. A warm interest in the final success that is looked forward to, and a lively sense of what will be its characteristics, must be presupposed; when this is given,—when this is cherished, not only will application be braced at every stage of instruction, but therewith the energy will ever be in prompt reserve which will carry the student on from one stage to another without losing touch of any that he has passed, without admitting obliviousness of any of which he has had but a general glimpse in the far beyond, and in advance. Study then becomes a growth, not an accretion; the development of a vital principle from within as much as an acquisition from without. The difference is the same which physiologists insist upon between the development of an organism under the inscrutable processes of vitality, and the building up of a crystal of alum, not to say the piling up of a heap of sand.

There are certainly considerable temptations for pupil as well as for teacher to rely upon piling up rather than building up, and upon building up rather than on the contingencies of organic development. No power of a microscope can distinguish in the egg any differences to account for the dissimilitude of plumage of a cock pheasant and a hen, or indeed to determine whether the bird, when successfully hatched, will be a pheasant at all. There is the same uncertainty for every one as to the outcome of human education. A youth has doubtless often a true consciousness of power, but sometimes,—too often, only a fallacious presumption; and if the state of such a case is a mystery, as the Germans might say subjectively,—how can it be less so objectively?—how can the tutor be expected to know more from the outside than the student himself from within? And so,—it were profane to say by a calculation of the long odds,—it is likely to be thought safer on both sides to assume the less promising contingency, and trust to systematic drill and brute memory alone, whatever the risk of unintentionally quenching a spark divine. The much-vaunted system of Jesuit education avowedly proceeds upon the principle of imparting results independently of any indoctrination as to the *rationale* of processes. The well-known Jesuits' perspective is an example that lies at hand for many. The problems which are there proposed are solved as satisfactorily as those which in a cookery-book have such headings as "To make a good gravy," or "To preserve Siberian crabs." In like manner we have before us a treatise on practical geometry, which, judging from its date, is now probably superseded in the military schools for which it was written some three-quarters of a century since. It is a fair introduction to that necessary rule of discipline that orders are to be obeyed without inquiry as to reasons. The pupil having to make a rectangle equal to a given trapezium, draws the line, and draws that at word of command, and then is gratified by the assurance "the rectangle thus drawn will be equal to your given trapezium; consequently your problem is executed."

Marvellous, indeed, is the power of memory in the young,—in all for some matters or other, and in some for all. It is not unfrequently easier for a youth to learn a long demonstration of Euclid by rote than to retain it by mastering the process of proof. The examiners of the competitive are amazed at fallacious results, and turn the screw still tighter to keep ahead of the crammer, and it is well if the ultimate results are not the preferment of the superficial, and the hopeless deadening by premature and unnatural strain of the highly gifted. Education, in consequence, tends to be reduced to a process of skilful and energetic packing, and wranglers are produced at a university

much in the same way as cartridges and rockets are filled at Woolwich. The same dangers beset the teaching of art; the hands of the pupil may be as utterly subjugated by one technical routine, their inventive energies comed, their imaginations atrophied. Artistic instruction is faulty which does not operate as actively to counteract the contraction of settled habits of hand as to ensure precision and dexterity within the particular range that the instruction covers. Discipline may be pressed so far that every horse a student ever draws in his lifetime shall remind of the Elgin frieze, and every ornament of the decorative details of a certain familiar Roman entablature.

But the pupil, whatever the art that he applies to,—simple draughtsmanship, ambitious design, or architecture,—must in all this be his own protector against the danger of being ground into a groove,—of being transformed into a machine. The secret of such protection lies in this, that even while rightly submissive to his teacher and duly observant of his models, he shall ever reserve a right of ultimate self-assertion, and a resolution to ask bold questions. Questions, he may say, of what nature? Even if no better suggestion is at hand, he may begin by asking himself whether truth may not possibly lie in the exact converse of what he has been used to accept as established beyond all question. He may begin by giving his most confirmed convictions a good shake if only to make sure that they will stand the test, and not come tumbling about his ears at once as convicted factitious prejudices.

"Diruit, ædificat, mutat quadrata rotundis,"

may be the course of the merely whimsical, but even caprice ere now has contributed more happily than it ever suspected towards breaking down obstructions to reform and to development.

The true balance which has to be sustained in the exercise of such tentative analysis is expressed in the verse of the Greek poet, which grammarians inform us is a trochaic tetrameter catalectic, but which dances, at any rate, precisely to the rhythm of

"Jolly mortals, fill your glasses, noble deeds are done by wine."

Thus sings the sage,—the Greek sage:—

"Be sober,—to mistrust be mindful; such the nerves of intellect."

Small blame be it to a beginner, then, if he calms down enthusiasm for the nonce even to ask such questions as,—"Was Raffaelle then really such a fine painter as he is reputed to be? Could he even draw? Could Michelangelo model? Was Newton a mathematician, Milton a poet, Wren an architect?"

Such questions cannot be asked and put to detailed and candid proof, without the justness of just reputations being recognised far more forcibly than when never subjected to challenge. And the result of the challenge of some time-honoured dogmas that might have seemed equally above dispute, may be very contrasted indeed. So it is that mere habits, fashions, and prejudices are broken down. Little credit to the paradoxical who abide in paradox for its own sake, and for the sake of tyrannising over the weak by forcing paradox upon them by mere glamour of highflying eloquence and mystifying rhetoric, and abuse of a reputation gained by better arts; but very much indeed to those who by courage and perspicacity lead the way into new unexplored, unexhausted, artistic regions, and leave behind the pert and the profane, no less than the incurably prejudiced.

To deny flatly and unreflectingly whatever is advanced, to speak evil of anything which has a claim to dignity, and there to rest, such is the well-known resource of the utterly barren; those who never can originate a proposition can find something to say in this form of direct denial when occasion is ministered to them by others more gifted with ideas; but no advantage ensues to the mere objector himself, and only the inexperienced allow themselves to be long involved in the coils of such a typical "bore contradictor"—we fear that it was Hallam whom Sidney Smith so qualified.

The greatest achievements of artistic invention have proceeded by way of gradual development or of comparatively sudden revulsion; in either case the improvement has been established by renunciation, more or less extensive and absolute, of what had previously been reverenced or blindly tolerated. In the development of the typical forms of the Greek vases, we can trace how one was superseded by another more refined, and how the perfection of one was only attained to be speedily renounced for a successful attempt at a new development of decided contrast; in like manner with the decoration of the vases, the earlier men who painted black figures on the natural coloured ground attained by degrees to a perfection in effect and design that left nothing to desire,—nothing to desire unless by the genius who reversed the process, and painted the ground dark, and gave scope for all the delicacy, all the force of pure line upon the lighter figures. The history of Gothic architecture especially is that of a series of rebellions of pupils against masters, gradual sometimes to the verge of timidity, but more frequently with the unscrupulous dash which was justified by consciousness of original power.

It is especially during the early years of pupilage that the student will do well to set value on the occasional suggestions of his own imagination,—the protests and hints of protest of his reason. Something far more pregnant than mere random denial in a spirit of contradiction will frequently lie at the root of spontaneous repugnance to an inculcated dogma; it is often a signal of nature rising in involuntary repudiation of an over-lauded precedent,—the sudden lifting of a curtain to allow momentary insight into a world of artistic combinations which it never would be given to authorised instruction to reveal. Many of those who have done most and best in even long and busy lives have admitted that their active lives were occupied, and fully occupied, in working out the thoughts of which the germs were presented to them before they were twenty-one. Fortunate they who prized the germs and tended them forthwith. How many have had experience in after-life that the success of rivals has been due to grasp of principles which had come unsought to themselves in early years, but only to be misprised, neglected, or forgotten. "Very strange" these revelations were, and it was a great mistake not to follow the advice of Hamlet, "And therefore like a stranger give them welcome." Do we hasten to shut one of these visitants out as an intruder and disturber,—to slam the door in its face as a tempter from our true allegiance? We have forfeited our chance of entertaining an angel unawares,—the unwelcomed truth retires and only greets us again, not to meet, but to cross our path, and to remind us, when it is too late to amend our error, of our ignorant and thankless repulse of proffered gold, and of all that we have had to travel and toil through with scant reward in consequence.

Students are to be warned, in fact, to respect their 'happy thoughts," to scrutinise their casual thoughts, which may be happy; so the chemists have made some of their best discoveries by attention to the despised refuse of processes of skilful manufacture, or to transitory phenomena that were merely incidental to the general direction of a verified experiment. A wit who has contributed his liberal share to the amusement of the day, has associated the phrase of "happy thought" with all that is ridiculous; but it is right to rescue it from undeserved contempt,—from the contempt which visits justly a foolish self-complacency in combinations which are destitute of real significance,—that are simply hap-hazard, not happy. If we penetrate to the heart of the mystery of any true artistic work we shall come to a happy thought, a germinative motive, which is in itself so simple, however elaborate in the working out, that it may easily have been seized originally at a moment, and might by the unobservant as easily have been missed. It was a momentary thought of Gibbon as he paced the nave of the Ara Celi at Rome, which decided his life's labour. His life's labour was further modified by his instant appreciation of another happy thought, to which a French acquaintance gave casual expression in his presence, that the main interest of the story of the decline of the Roman Empire must lie in the narrative of the Rise of the Barbarians. A happy thought married, in George Stephenson's favourite metaphor, the "Locomotive to the Rail"; and whether the momentous apple had really any concern in the matter or not, the extension of the familiar conception of gravitation to the scope of universal gravitation, which was to harmonise all the movements of the heavenly bodies, may have been the neglected happy thought of many before it was arrested by the majestic intellect of Newton.

A sentence of Col. Perronet Thompson,—it remains in the mind from the days of anti-Corn-law agitation which, to the dominant generation, are now only known of as history,—might have been written in letters of gold in every studio and office where aspiration to brilliant originality is intent to watch for or to make its opportunities. "Whenever," he wrote, in simple English phrase,—"whenever you get hold of a respectable analogy, evolve it, chase it, ferret it out." Such analogies present themselves suddenly, fleetingly,—so fleetingly at times that those who are best aware of their value have some trouble in pursuing their flight the very moment after, and recovering the rapidly-fading outline of which they had a momentary glimpse, but of which even so they were alert enough to recognise the value.

INSTANCES OF ACCESSORY ART.

The book produced under this title* by Mr. Day is an able as well as a very attractive one, which is more than can always be said even of the most elaborate works which have been put forth on the subject of decorative art. It consists of about thirty prints, illustrating various phases of decorative design, and each accompanied by a short essay comprised in a single page, in reference to the special point illustrated in the corresponding print. The remarks contain a great deal that is very true and suggestive, and show that the author is not only able to draw and design well, but that he has just and well-balanced views upon his art, and is able to express these in a good and clear literary style.

We may congratulate the author on being apparently free from the trammels of any particular fashion in decoration. He is neither a naturalist nor a rigid conventionalist, and keeps fully before his readers the fact that right conventionalism in ornament is not to be obtained by adopting a special system of conventionalising natural forms, and thus putting them all, as it were, through a mill of decorative manufactory, but by a consideration of the circumstances of each design; its object, the material in which it is to be worked, and the degree of adaptation which the particular natural type that has been adopted requires to render it properly subservient to the decorator's purpose. The first illustration which illustrates the remarks on "principles of decoration" does not at first sight seem to have any special bearing on so large a title. But it is given, as we find when we turn to the letter-press, as one example of fitness of treatment of a special subject, which may serve as an indication of the general objects to be aimed at in adapting natural forms to decoration. It is a tolerably naturalistic scroll pattern for needlework, consisting of a combination of apple and mistletoe. There is not one only way, says the author, of treating these plants ornamentally, but many ways,—as many as the purposes to which such ornament is to be applied. "The special considerations in this case are: that it is a border, and should, therefore, form more or less of a definite band; that it has to be repeated, and therefore should not be so natural as to lose by repetition; that it is to be worked by hand, and therefore should not be so stiff and uninteresting as to be unworthy of the labour of patient stitching; that it is to be seen from near, and therefore should not be coarse; that it is decoration, and therefore should not be too self-assertive." All these requirements are well illustrated in the design. The last remark touches on what is a leading principle in the book, that decoration should not outstep its province and become in any way pictorial. On this most of us are agreed in theory, but it is not always observed in practice. Accompanying the third illustration, "Consistency of Style," are some useful remarks in regard to the manner of using old styles as a starting-point for modern work. The design, in inlay, for the front of a cabinet, is designed with the idea that it should not clash with the work of about a hundred years ago, yet that it should not be a mere imitation of the style of the Adams.† In this object, by no means easy of attainment, the author has succeeded very well, and exhibits a design decidedly superior in feeling to that of the Adelphi firm, while, at the same time, it shows sufficient affinity with their work to take its place in a collection of furniture of that school without appearing out of keeping.

* Instances of Accessory Art: Original Designs and Suggestive Examples of Ornament, with practical and critical Notes. By Lewis F. Day. Batsford, London, 1880.

† Mr. Day writes the "brothers Adams," which is a common mistake. Their name was Adam, without the final *s*.

In a design entitled "A Suggestion from the Acanthus Scroll," the author suggests tentatively a wide field for the interest of those who wish to cultivate originality in ornament, a field most strangely and unaccountably neglected, viz., the application of other natural forms to ornament of a Classic style and manner, instead of merely repeating for ever and ever the acanthus and the anthemion. This is a design of a panel, such as might be executed in partially carved and partially pierced woodwork (the author does not mention for what particular material he intends the design), consisting of a conventional treatment of the chrysanthemum, the flower of which, thus treated, makes a kind of anthemion, though of a different growth and outline from the typical Greek anthemion. The design is distinctly Classic in character, yet bears no positive resemblance to any Classic or Renaissance work; it looks a trifle ragged, and deficient in breadth of surface, but the author is convinced that the inferiority of his design to Roman or Renaissance work "is attributable to the inferiority of the designer to the masters of the Classic or the Cinque-cento period, and not to the less manageable nature of the chrysanthemum." A flower which presents somewhat long, narrow, and ragged leaves is on the whole, we should say, rather less manageable than the acanthus, which is quite a decorator's leaf ready made; but it may also be remembered that the finest employment of the acanthus in the Corinthian capital, though so perfectly successful in the form in which we know it, was no doubt the result of the tentative efforts and gradual improvements of many hands. Really original and at the same time successful ornamental design is a thing seldom achieved by any one at one step, but Mr. Day's specimen makes an admirable suggestion.

The single example of stained-glass figure-work which is given is not original, but is taken from a window at St. Mary's, Ross, of Late Gothic work, and is, as the author observes, exceptionally good in regard to drawing and the general grace and composition of the figure. The remarks accompanying this design include some strictures on modern Mediæval figure-design in stained glass, which we are glad to read, and which entirely fall in with what we have often urged as to the absurdity of representing the most important and serious incidents of religious or theological history through the medium of an art voluntarily binding itself in Mediæval fetters in regard both to drawing and general conception. We may quote the concluding sentences of Mr. Day's chapter,—"A realistic rendering of the scene of the Crucifixion might be offensive, and an ideal picture must of necessity be inadequate; but it seems to me that nothing could well be in worse taste than our mock-Mediæval rendering of such subjects. Many a man must in his heart feel that some subjects are of so much more importance than decoration that it would be degradation to submit them to decorative treatment. In that case, he had better not mix them up with decoration at all, for whatever is introduced into decoration should conduce to decorative oneness."

Mr. Day had better have been content with saying "unity," for "oneness" is a singularly clumsy expression, but in the remarks we have quoted there is good sense, both from a decorative and from other points of view. The reduction of such a subject as the Crucifixion to a mere decorative treatment in stained glass, often executed in an almost mechanical or trade spirit, is discreditable both to those who produce and those who are content with it. It is a subject that should call forth the highest and most pathetic expression of which art is capable; and such expression and pathos, in figure subjects, cannot be realised in such a material as stained glass. We have got so used to this decorative treatment of lofty subjects that we are apt to overlook its unsuitability, which cannot be too plainly pointed out. In the notes to another illustration, entitled "Ecclesiastical Art," the author does good service again in drawing attention to the want of reference to nature in the treatment of some of the flowers and fruits frequently used as symbolic accessories in church decoration, and the mechanical repetition of forms the conventionalism of which is not founded on nature at all.

The chapter on "The Adaptation of Natural Forms to Ornamental Design" touches on a very large subject. The author indulges in a rap at some of the conventional foliage of which we have seen a good deal of late years, saying that "a ghostly kind of ornament came into fashion at South Kensington and elsewhere, consisting of the forms of leaves and flowers arranged upon a geometric basis. The natural forms were invariably flattened out as if they had been put into a press, till the effect of these designs (so-called) was more suggestive of dissection than design." There is no doubt a good deal of truth in this; but, on the other hand, due credit must be given to this school of floral convention in design for ridding us of a great many bad attempts at naturalism in materials and methods which did not admit of it. The author considers that the way out of the dilemma was shown us by Japanese art, though he admits (and we are glad to see the admission) that, this art having come upon us by surprise, and as a new discovery, we "fairly went mad about it." But he thinks that, in sober earnest, Japanese art showed us how to adapt natural forms without taking the nature out of them. We are hardly disposed to go as far as this. A great deal of what is called Japanese decorative art is really painting, not decoration: painting done as realistically as the artist was able to do it, only not upon a canvas, but upon the surface of some utensil, so that it came to be regarded as decoration. Mr. Day should certainly have been one of the first to see this, since he has drawn the distinction so pointedly in his preface. The two panels which he gives in the plate, showing the application of natural forms to ornamental design, we should hesitate to accept as such. They are to us more like drawings of flowers trained up straight, and confined within by the bounding lines of a panel. They are very pretty, but they have hardly the intellectual interest which attaches to ornamental or decorative design, properly so called. The treatment of a rose-spray in the next illustration is exceedingly happy, in the conventional and yet perfectly easy-looking twist given to the stalk and leaves, and the reduction of the flower to the simplicity necessary for decorative treatment, not by modifying its character so much as by reducing the number of its petals. A rose is really one of the most difficult of all flowers to treat decoratively, it is so rich in the fulness of its life and fragrance, while at the same time rather bulbous and deficient in marked outline, that any attempt to adapt the natural flower in decoration is apt to seem almost a libel on it. By simplifying it into a flower with fewer petals, still retaining their full outline and super-imposed arrangement, attention can be directed to the delicacy of form and slight foldings of the individual petals, which are qualities that the decorative draughtsman can satisfactorily deal with.

Among the other drawings, a very good one is that which illustrates "The Growth of Ornament"; an ornament being shown which has somewhat of a general vegetable character, but which, in fact, is an imitation of no vegetable form, but of the principle of growth. This is a good example of the more abstract and metaphysical kind of relation that may exist between nature and decoration. "The Fault of Hardness" is well illustrated by two repetitions of a floral stained-glass design; the one in absolutely hard, black, white, and shaded tones; the other with the hardness of contrast reduced by variety of surface; the latter is, however, a trifle overdone, and looks like artificially-dirtied glass. There are a good many other pretty and suggestive designs, one showing what can be done with "brush-work" alone, with the varying thicknesses and easy sweep of line to which the brush lends itself so well when deftly handled; another showing an admirable bit of workmanlike design from a piece of earthenware in the possession of the author, and which has been scratched with a design of fine and bold type, executed in a manner which shows how precisely the workman understood how to produce the best effect with the rough and ready means at his disposal. The only one we object to is that for door-decoration, where the author has adopted the habit, which has become fashionable, of carrying a foliage design over all the panels, as if passed under the stiles; a method of design which contradicts the real construction of the door, and is in every way clumsy and ill-adapted to the position. But there are really so few faults to be found with the book that we can very well condone this. It is one of the best suggestive publications on decoration that we have seen for some time, and we cordially recommend it to the notice of our readers.

IRON AS A MATERIAL FOR ARCHITECTURAL CONSTRUCTION.*

THE object of the present paper is to trace out the use, progress, and capabilities of iron as a building material, and to inquire in what direction these capabilities are leading us, and what influence they are likely to exercise on construction and design in the future.

Neither in the description of the palace of Alcinous ("Odyssey"), nor in that of Solomon's temple, is there any mention of iron as a structural material, but it appears to have been used for tools and for securing other materials, for it is recorded of the latter as remarkable "that there was neither hammer nor axe nor any tool of *iron* heard in the house whilst it was in building." It is also stated that King David in his collection of materials included "*iron* in abundance for the nails for the doors of the gates, and for the joinings" (probably hinges).

There are many allusions to iron in the Old Testament Scriptures. Some passages are of a figurative character, where iron is the emblem of hardness, strength, and power. Others are descriptive, and indicate the uses made of iron in those early times. It formed one of the articles of commerce at Tyre. The rough material was brought from Tarshish (Spain). Bright iron was procured from Javan (probably Ionia). It was used for tools and implements. Iron yokes, axes, hammers, instruments with iron teeth, are spoken of. An iron pan is mentioned by Ezekiel.

The manufacture of iron existed in India from very remote antiquity, though carried on in a very primitive manner. Vast accumulations of slag and cinder are found spread over large areas in various districts, and the manufacture is still carried on with little change from the ancient processes. In the mosque of the Kûtub, near Delhi, there is a wrought-iron pillar 60 ft. in length, dating from the fourth century of our era. It is only of late years that the production of a shaft of this dimension would have been possible in England.†

There is extant a fragment of Agatharchydes, a Greek author of the first century, quoted by Diodorus, in which, giving an account of the metallic productions of Egypt, he states that various bronze implements are found, but no iron. It has been thought by some that the Egyptians were acquainted with a method of hardening bronze tools which has been lost. This is very improbable, and we must leave the matter as a *crux antiquariorum* for future solution.

The Greeks obtained their iron from the Chalybes, a nation dwelling on the south coast of the Black Sea. Æschylus calls them "σιδηροτίκτονες Χάλυβες," "the iron manufacturing Chalybes," whence the term χάλυψ, for steel. Steel was at that time produced directly from the ore. The process of hardening the steel by plunging it into water is alluded to by Homer in describing the action of Ulysses in putting out the one eye of the giant Polyphemus.

The use of iron by the Romans was of rather late introduction. The fine specular iron of the Isle of Elba had been smelted by the Etruscans from an early date, but it seems not to have been very extensively used in Italy. It was not until the time of the second Punic war that the Romans extending their conquests beyond their original narrow seat, obtained supplies of iron and steel from Spain and Noricum, and discarded their bronze weapons for the harder and keener metal. Iron, however, was little used by the Romans, in building construction. When Virgil describes the splendours of Dido's rising city, no mention is made of iron in any form; stone with the addition of bronze for plating are all the materials mentioned.

Vitruvius, in his celebrated treatise on architecture, makes very little mention of iron, or of metal at all. In the New Testament, Acts xii., 10, mention is made of an iron gate, and no doubt at that period iron had been brought into use in many useful forms, more however in the way of machinery, armour, and weapons, than in building construction. For all constructive purposes bronze became gradually superseded

* From a paper by Mr. James Allanson Picton, F.S.A., read before the Royal Institute of British Architects on Monday evening last, as elsewhere mentioned. The paper *in extenso* will be found in the Institute "Transactions," any separate part of which, it is as well we should occasionally remind our readers, can be obtained at very small cost.

† A cast of this shaft may be seen in the South Kensington Museum.

by iron, which during the Middle Ages was worked with great skill and success. The wrought-iron so employed did not undergo the process of fusion and puddling, but was obtained direct from the ore by roasting with charcoal, and working under the hammer. The metal thus obtained was of excellent quality, and was very skilfully manipulated. Armour and weapons attained a high degree of efficiency, and were finished with great taste. Although not employed in constructive building to any great extent, yet in the accessories, iron was in the Middle Ages treated with a freedom, and worked up with an elegance of design, which have never since been equalled. To a certain extent the Romans had made use of wrought-iron for ornamental purposes, the few fragments which remain containing evidence of their skill, but in the dismal period which followed the breaking up of the Western Empire, the art became practically lost. It is to the rise of church architecture, and to the influence of the monasteries, that we owe the development of this as of so many other arts.

Two descriptions of Mediæval smith's work are especially worthy of notice; the well-covers, and the grilles or iron screens. Unfortunately, there are not many of the first remaining in anything like perfection, but sufficient fragments are in existence to indicate their extreme beauty. The rich and graceful curves, the combination of lightness and strength, show us what capabilities exist in iron when freely treated in accordance with its nature.

Probably the grilles or screens, and the gates of the Middle Ages exhibit the art of the smith in its greatest perfection. Of these, multitudes remain, of an infinite variety of design, no two being exactly alike. The wonder arises that, with such simple means, such wonderful effects could be produced. I may mention as worthy of notice the grilles in St. Gudule, at Brussels, that round the tomb of Queen Eleanor at Westminster, St. Denis in France, and the tombs of the Scaligers at Verona. These glories have passed away, and circumstances have so changed as to prevent a possibility of their return.

During the Romanesque period, iron does not seem to have been employed either in carpentry or masonry. At the end of the twelfth century, iron cramps were employed at the Cathedral of Notre Dame at Paris to connect the stones of the corbelled cornice. The oxidation of these cramps in the course of time had the effect of fracturing the stones. A similar result occurred at the Sainte Chapelle, from the introduction of iron chain-bond into the walls. Experience in this practice does not seem to have taught wisdom, for even at the present day the mistaken use of iron in similar positions has frequently led to the same results.

The Mediæval period of the use of iron may be said to have terminated about the middle of the sixteenth century. Down to that time cast-iron was unknown. The discovery of the process by which fusible iron could be smelted from the ore we owe to Germany. It probably arose from the gradual improvement of the blowing-apparatus, by which the old blast bloomeries were transformed into blast-furnaces. About 1550 the system was introduced into England, where there already existed great facilities in the enormous quantity of scoriæ accumulated about the ancient bloomeries, and in the abundance of timber for fuel. Cast-iron ordnance was an article of export from England early in the seventeenth century. As the art of the moulder progressed, the art of the smith began rapidly to decline. The cheapness of cast-iron and the facility with which it could be manipulated, led to its extensive use in every department of life. The balustrade round St. Paul's is a good example of the early adoption of cast-iron for such purposes. This was manufactured at the Sussex Iron Works, where the abundance of ore led to a profitable trade, until the remains of the ancient forest of Anderida, which had furnished the fuel, became exhausted. It was not until the year 1735 that the problem of smelting iron with pit-coal was successfully solved by Abraham Darby at Coalbrookdale.

It is remarkable within what a recent period the advantages of iron on any great scale have developed themselves. Down to the commencement of the present century the casting of iron pipes was so difficult and costly an operation, that in schemes for the supply of water to towns, wooden pipes, consisting of elm stocks bored up the centre and socketed together, were adopted for the mains.

One of the earliest uses of cast-iron in public works was in the construction of bridges. Bridge-building forms the border line between architecture and engineering. Old Westminster and Blackfriars bridges were designed by architects, but since the erection of London and Southwark bridges, and particularly as applying to iron structures, the work seems to have been handed over exclusively to the engineer.

Soon after the discovery of cast-iron in the sixteenth century, proposals were issued for its adoption in the erection of bridges in Italy. The matter slumbered for nearly two centuries, and in 1755 the subject was revived in connexion with a proposed bridge at Lyons, but the project was afterwards abandoned. In 1777 the first iron bridge was erected at Coalbrookdale, in Shropshire, from a design by Mr. Pritchard, an architect of Shrewsbury. It is a cast-iron arch of 100 ft. span, constructed with continuous ribs, and although not exactly fulfilling the theory of its designer as to its being an arch of equilibrium, it displays great skill, and has stood with success the test of a century's traffic.

In 1796, another cast-iron bridge was erected over the Severn, at Buildwas, by Thomas Telford, 130 ft. span. The same year witnessed the completion of the celebrated iron bridge over the river Wear, connecting Sunderland with Monk Wearmouth. This structure is remarkable from the boldness of the design, the novelty of the principle adopted, and the mystery which has hung over its actual authorship. It has usually been attributed to Thomas Paine, and is so recorded by Mr. Robert Stephenson and Mr. Samuel Smiles in their respective works, but more recent investigations have proved that the bridge was designed and erected by Mr. Roland Burdon, M.P. for Durham, with the assistance of Mr. Thomas Wilson.

Another bridge erected on the same principle at Yarm, by Mr. Wilson, in 1805, unfortunately fell down in the following year. The finest example of a bridge, erected with cast-iron voussoirs, and one of the latest so constructed, is Southwark Bridge, built by Rennie in 1814, with a central arch 240 ft. span, and two lateral arches 210 ft. span.

The next development in iron bridge building was that of the suspension principle, of which undoubtedly the most beautiful specimen is the Menai Bridge, erected by Telford, and completed in 1825. The design, prepared in 1814, was originally intended to span the River Mersey at Runcorn, on the site of the present railway bridge, but the funds not being forthcoming the matter was laid aside, and revived in 1819, when Telford was employed in improving the communication with Holyhead. This bridge is 460 ft. between the piers, with a versed sine of 40 ft. Nothing could be more graceful or fairy-like than the contour of this structure, the stability of which has been tested by more than half a century of use.

The erection of the tubular bridge over the Menai was preceded by many interesting experiments by Messrs. Fairbairn and Hodgkinson, which threw a flood of light on the nature and strength of the metal. The result in the bridge as executed is no doubt satisfactory as to strength and stability; but neither economically nor æsthetically can it be pronounced a success. The quantity of material far exceeds the necessities of the case, and compared with its sister structure it must be pronounced unsightly in the extreme. The latest development in iron bridge building, and that which bids fair to supersede the others, especially for railway purposes, is the lattice, the principle of which, scientifically applied, combines the greatest amount of strength with the utmost economy of material.

A very satisfactory example of this principle is to be found in the London and North-Western Railway Bridge over the Mersey at Runcorn, designed by the late Mr. Baker, but in length, span, and dimensions, it is far exceeded by the viaduct over the St. Lawrence, and others since constructed. The most notable, owing to recent unfortunate circumstances, is the Tay Railway Bridge, two miles in length, in eighty-five spans, from 245 ft. downwards. Several principles of construction are introduced, the larger spans having lattice-girders, the smaller ones some bowstring, and some plate girders. This is not the place, nor has sufficient time elapsed, for analysis or criticism. A single remark, however, may be ventured. Experiments in tensile strength and bearing power may be perfectly satisfactory, and science and skill of the highest character may be employed, apparently leaving nothing to be desired; but there is one factor outside all these which it is possible to forget,—that is, the element of simple dead weight, which offers a resistance to the elements, without which science may struggle in vain. The Britannia tubular bridge may be criticised for its wasteful expenditure and its unsightly appearance; but nothing short of a convulsion of nature could remove it from its base. The proposed railway bridge over the Forth at Queensferry, if ever executed, bids fair to surpass all its predecessors. Girders, with a span of 1,600 ft., and towers, for the purpose of suspension-chains, nearly 600 ft. in height, almost take away one's breath in the conception; but there is no limit to human daring when backed by science and skill. The facilities afforded by wrought-iron and steel are destined to carry the art of bridge-building to an extent utterly inconceivable in previous times.

To the extension of the railway system, combined with the use of wrought-iron, we owe the progress of roof-construction. So long as timber was the only material available, the span to be covered was necessarily very limited, 90 ft. to 100 ft. being the extreme. The celebrated riding-school at Moscow had a span of 235 ft.; but its construction was not successful, and it had no imitators.

In the construction of floors, the improvements in the manipulation of wrought-iron have provided special advantages. The ponderous and treacherous cast-iron beams have been replaced by wrought rolled girders for moderate spans and riveted I or box girders for those of greater extent, whilst smaller scantlings of all forms can be had for every requirement. Our French neighbours have availed themselves of these advantages to a greater extent than prevails in England. A large proportion of the modern buildings, both in Paris and in the provinces, have both roofs and floors fireproof. The main beams, cross girders, and joists are rolled iron, with light iron laths or bars dropped in between the joists, resting on the lower flange. A coat of concrete is spread over all, forming a solid durable floor. A wrought-iron floor has recently been constructed for the new reading-room at the Liverpool Free Public Library, a circular building 100 ft. in diameter, without any support from columns or piers.

The progress of wrought-iron has not been confined to building construction. In marine architecture it has effected a complete revolution, and in so doing has placed our own country far in advance of every other nation. The first sea-going iron ship was the *Richard Cobden*, built in Liverpool in 1844, by Jas. Hodgson & Co., 522 tons burden. Some years elapsed before the example was followed to any great extent.

We have thus cast a hasty glance at the progress of iron construction to the present time. The inquiry remains, what is to be its influence in the future? That it will contribute materially to aid man's power over the material elements of nature is certain. The moral results lie beyond the province of this paper, but it may be permitted to cast a forward glance at the probable influence of iron in one department, that of architectural construction and design. To what extent can iron be advantageously employed by the architect, and how far will it affect the æsthetic character of his work? All true design arises out of construction. Every style which has attained any eminence owes its effect to the adoption of its essential parts as sources of beauty, rather than to any attempt to conceal them. The use of iron, whether in construction or design, is a new source of power and effect put into the hands of the architect for good or for evil. The adoption of a new material should lead to new canons for its suitable employment, or rather to new applications of the eternal principles of truth and beauty.

Mr. Ruskin, who may justly be called the Coryphæus of architectural critics, has some pertinent remarks on the use of iron in architecture.

These were written in 1849, before the era of Great Exhibitions, Crystal Palaces, enormous railway-station roofs, and previously to the great improvements in the manufacture which have so much facilitated the employment of iron. At the present day it is scarcely probable that he would have written as he did.

The principal use of metals, including iron, we are told, is as a cement for connecting stones together. Every practical builder knows that

for this purpose iron is about the worst material that could be employed, its operation being to disintegrate and separate by its oxidation and expansion, and to destroy rather than support.

The unfortunate cast-iron spire of Rouen Cathedral I give up as deserving the severest reprobation of the critic, not because of its being iron, but for its tastelessness and incongruity; but what about "the iron roofs and pillars of our railway stations," which we are told "are not architecture at all"? Writing thirty years ago, there was very little in such structures to attract admiration or attention; but look at them now. Westminster Hall, apart from its historical associations, in its wonderful roof exhibits a signal example of skill and beauty combined. This, says Mr. Ruskin, is true architecture. Turn, then, to the railway station at St. Pancras, with a noble roof four times the span of Westminster Hall, in the construction of which simplicity and skill have produced a result perfectly satisfactory to the eye on the score of strength and stability, whilst the grand sweep of its gigantic curves fills the mind with a sense of harmony and fitness which it is difficult to separate from a feeling of the beautiful. Why are we to deny to structures of this class the claim of being "true architecture"?

Surely the ultimate or radical principle of all true architecture is to use the materials within our reach in such a manner as will bring out their capabilities most efficiently for strength and commodity, and superinduce upon their employment such decorative forms as the nature of the material may suggest. It is on this foundation that every style which has obtained a footing in the world has been based. What can appear more opposed to each other at first sight than the pure Greek of the age of Pericles, and the pure Gothic, say, of the thirteenth century? Yet, diverse as they seem, they are equally developments of the principle of truth and adaptation. The materials of both are stone, but the Greek stone being marble, led to a delicacy and refinement of detail of which the Northern style was incapable. Given, then, the material to work with, and keeping in view that the main idea of the one was trabeation or horizontality, and that of the other pointed arcuation, the mind can follow the consistency and adaptation of all the parts, even to the minutest detail. Now, can any one doubt for a moment that if iron had been equally available at the two periods in question, the genius which designed the Parthenon, or that which soared aloft in the nave of Amiens or the choir of Le Mans, would have been equally successful in the design of a metallic structure, especially looking at the beautiful bronze works of the Greeks, and at the rich fancy which characterises the metal works of the Mediæval artists? To prohibit such an attempt, or to limit the exercise of invention, would be "to put a yoke upon the necks" of our rising architects, "which neither our fathers nor we were able to bear." The mischief arises from the attempt "to put new wine into old bottles," to cramp and confine the use of the new material within the lines of the old, with which it is altogether incongruous.

When the scheme for the first Great Exhibition in 1851 was launched, designs and proposals of all sorts were broached as to the design and construction of a suitable building. They all fell flat, and were pronounced by the public voice to be cumbrous and unsuitable, being based on the conventional forms of brick or stone building. In a moment of inspiration Sir Joseph Paxton pointed out how the difficulty could be surmounted by a structure of iron and glass. It is easy to ridicule this as a mere gardener's idea of an enlarged greenhouse. When Columbus made the egg stand on its end by giving the shell a slight bruise, the bystanders exclaimed that "anybody could do that," but the same fertile imagination and readiness of expedient led to the discovery of the New World; and Paxton's happy thought has been further expanded and developed so as to furnish a principle of construction now universally adopted in all buildings for a similar purpose. Where a large area has to be covered for bringing together a numerous assembly for a temporary purpose,—such, for instance, as the Kibble Palace at Glasgow,—there is no material and no mode of construction so economical and effective as the combination of iron and glass. It is, in fact, a tent constructed with durable materials. Modern improvements in the manufacture of iron have rendered that easy which would formerly have been impossible.

But it may be said this is a development in one direction only. What about houses, public buildings, churches, street architecture? I am not preparing a book of designs, nor can I point to a visible embodiment of the tendencies I am pointing out; but in all these departments there is progress already attained, and a reasonable prospect of further rapid advance. I have already alluded to the increased employment of wrought-iron in the roofs and floors of private buildings, especially in France. Beyond the merely constructive portion, its use is extending in dome-lights, galleries, entrance-doorways, windows, and balconies. In public buildings and churches there has been a timidity in the use of iron for roofs in a manner to combine strength with beauty. The iron roof when adopted is usually concealed. If an ornamental or decorated open roof is designed it is usually of timber, except vaulting is introduced. There seems no good reason for this neglect. The adoption of iron might, in the first instance, require more invention and thought; but the great advantage of security from fire should be a sufficient inducement for the change. In all roofs of great span the facilities of iron have utterly discarded timber. Street architecture, especially of a commercial character, seems to afford a wide field for the application of iron in a decorative form; but the hand of skill combined with taste will be requisite to prevent its becoming an abortion. Nothing could be more odious or repulsive than long lines of glazed fronts, with no relief but flimsy metal bars, looking like houses of cards ready to fall with a breath of wind or the slightest concussion. I have known structures of this kind, perfectly safe in reality, with an outward aspect so flimsy and insecure that tenants were afraid to trust themselves within the precincts. The true principles are not far to seek. The main lines should not only be strong, but made to appear so,—massive if you will, exhibiting weight as well as strength. Within these outlines there may be wide open spaces, where the true artist can exercise his taste and give fair play to his fancy in a material plastic enough to take any form, strong enough for protection and resistance, and light enough to irradiate the interior even in the murky atmosphere of a city. We are not without hints, even from the olden time. In many of the frescoes on the walls of the Pompeian houses, or of the ruined halls on the Palatine, there is a style of architecture displayed which may be the mere fancy of the artist, but which, whilst preserving the leading forms of classical design, exhibits a lightness and grace which would easily serve for models for execution in metal. Many of the shafts of bronze candelabra display the same grace and elegance of form. Amongst the arabesques of Raffaelle in the Vatican there is a display much of the same character. There is ability enough amongst our modern race of architects, if this course were pursued, to strike out a new path for the progress and adaptation of metallic, and especially wrought-iron construction, which would undoubtedly lead to advantages and results not hitherto anticipated. It would be invidious to mention specific cases, but instances might be pointed out in which, proceeding somewhat on the lines here laid down, the result has been fairly satisfactory.

ARTISTS IN MUNICH: 1874—1879.

AT a first glance it may seem that the subject of Munich has been exhausted by Miss A. M. Howitt's delightful and interesting book, "An Art-Student in Munich," more especially as a new edition has recently been published, with one or two additional chapters of later date; but on examination it will be seen that those recollections leave off where these begin, viz., with the death of Kaulbach.

But even this event, unconnected as I was in every way at that time with Munich and its artists, had some influence on my plans, as it also most likely had on my course when once in Munich. On the news of Kaulbach's death reaching England, my friends would not hear of my going to that cholera-stricken place; and I must choose between Paris and Dresden. My choice fell on the latter, because I hoped to be able to get on thence to my much-wished-for goal, Munich, which I accordingly did after a few months' stay in Dresden.

Miss Howitt's glowing description of the town was not unknown to me, but I may perhaps be pardoned if, at the first blush, I did not see everything in so roseate a hue. Arriving, tired and starved, after a twenty-four hours' journey, without being personally acquainted with a creature in the place, with a very imperfect knowledge of the language, and no definite address on my letter of introduction, it is not surprising that I got out of the train without admiring the frescoes on the station walls, or that I stood beneath the Byzantine colonnade of the station yard without appreciating the good architectural effect and perspective of the aforesaid colonnade. A more prosaic view is nowhere possible than that of the Munich "Bahnhofsplatz"; and I asked myself, Is this the poetical, inspiring Munich I have read of, the home of Kaulbach, the scene of so many of the labours of Cornelius, Hess, Schnorr von Carolsfeld, and Schwanthaler? Leaving for the time this desponding question unanswered, and looking up the missing address in the Directory, I seated myself in a droschky and set forth. As we emerged from under the linden avenue of the Sonnen Strasse, and crossed the Sendlinger Platz, with its splashing fountain and showy flower-beds, and to the left the old red brick Sendlinger Thor, with the peaked and gabled roofs of the city rising up beyond it, crowned by the lofty towers and cupolas of the Frauenkirche, came upon my view, my spirits began to rise, and a great longing came over me to pass under the hoary, doorless gateway, and wander among those strange old streets and houses. Time had laid his consecrating and beautifying hand on these, enchanting them with the charm which is his own special prerogative.

My first steps in Munich were turned towards the *atelier* of Kaulbach's successor as director of the Academy, Carl v. Piloty. I often wonder how I should have fared with his predecessor had I gone to him as I did to Director Piloty, with no other introduction than my zeal to work and entire strangeness in a strange place. A fellow student of later days, who was intimately acquainted with Kaulbach and his family, said he used to much object being intruded upon by strangers, "especially those English, with their blue gauze veils and red Baedekers." But I had been told that Piloty was very amiable, and always willing to give advice: so I proceeded, if with faltering step and palpitating heart, through courtyard and passage, and up a long flight of stairs, until a door was reached whose gigantic proportions made me feel more pigmy-like and insignificant than ever. With trembling hand I knock, and, obedient to the "Herein" from within, enter, and find myself in the presence of one whose majestic height was quite in keeping with the proportions of the door which had so imposed me: this was the director himself, who at once accosted me with the inquiry, "Was wünschen Sie, mein Fräulein?" Alas, for my carefully-prepared little speech! I fear it came out backwards; but the kindly face looking down on me was reassuring, and I explained my situation and asked advice. This was most kindly given, and from the number of names recommended as being good masters there seemed to be a large choice. I was fortunate in finding in the studio a just-completed work, the "Thusnelda," now the property of the State, and worthily lodged in the new Pinacothek. Colossal in its proportions, brilliant and glowing in colour, striking in effect of light and shade, and grand and harmonious in its composition, it is a work which fully maintains the painter's fame. The centre-point of interest in the picture, and in the triumphal procession of which she forms a part, is the captive Queen Thusnelda; white-robed, with flowing golden hair, one hand resting on the shoulder of her seven or eight year old son, she passes with stately and unconquered mien the throne of the Roman emperor, who, raised on a dais, under widespread awning, surrounded with his court, looks down on the spectacle; groups of prisoners, slaves, and soldiers, together with the spoil of war and other accessories, are most vividly depicted; but the eye wanders back from them all, and rests with admiration on the figure of the queen. Director v. Piloty took much pains to explain to me who the different figures represented were, and I was delighted with everything.

This picture is no mean representative of that realistic tendency so rapidly developing in German art, and more particularly in the Munich school, an art which appeals more to the eye than to the mind, which revels in colours and textures and striking chiaroscuro effects, and whose chief exponent is Hans Makart of Vienna, a pupil of Piloty's, and

fellow-student of my highly-esteemed master, Herr Joseph Flüggen. Thus it will be seen that a transformation in the character of the Munich school has taken place since the time of Kaulbach and his contemporaries; it is neither my object nor my wish to discuss the respective merits and demerits of these two schools; that has been often done by more able pens than mine, but it is apparent that a school whose great excellence consists in the technical and outward attributes of painting, must offer many advantages to the student who wishes to become the master of the best means for expressing his ideas. This, after all, is all that can be taught. However much stimulated and emulated by the example of others, the artist must possess in himself those powers of poetry and imagination without which no art can be great in the highest sense of the word.

Having mentioned Hans Makart, of Vienna, the pupil of Piloty, whose name is, perhaps, best known in England, I am led to notice a peculiar characteristic of Piloty's teaching. Not, as might have been supposed, have his pupils become mannerists. I have heard this danger quoted as an argument against the system of training artists followed in Munich and other Continental schools. It is true such a result may sometimes accrue, but Piloty's pupils form a very striking argument that such a result is not inevitable. Very much, of course, depends on the ability of master and scholars. Those who are acquainted with the productions of Gabriel Max, Franz Defregger, Hans Mackart, Josef Flüggen, Alex. Liezen Mayer, and Max Adamo, will be struck by the entire dissimilarity of their work, and by the original way in which each artist has preserved a strict individuality both in subject and the treatment of it.

One picture by Gabriel Max has, I know, been exhibited in London, "The Lion's Bride" ("Löwenbrant"). Those who have seen it will remember the soft handling of the technique, combined with solid modelling and severe drawing, together with the rich and subdued colouring. Characteristic, too, of the painter is the subject. Seldom does he fail to introduce a corpse, which, however finely and ideally treated, cannot fail, at last, to degenerate into unhealthiness. The "Infanticide," "Blind Girl in the Catacombs," "The Martyr," and "The Landlady's little Daughter," from Uhland's charming ballad, "Der Wirthin Töchterlein," are also from his hand.

The name of Defregger will ever be connected with that of his native country, the Tyrol, whose many varieties of peasant life he never tires of representing; a true son of this beautiful land of green valleys and snowy peaks, he knows how to represent its people with a literal and ideal truth quite unequalled,—whether the scene represent victorious peasants returning from an engagement with the French, or a homely scene of "saying grace" or "playing the zither," in all there is the utmost truth of expression, type, costume, and surrounding detail, combined with careful execution and artistic effect. A recent picture of life-size dimensions represents "Andreas Hofer taking leave of his fellow-countrymen and prisoners in the fortress of Mantua on his way to execution,"—a work this which appeals strongly to the highest emotions, as the broad stalwart figure of the patriotic peasant is seen standing calm and firm as a rock, and is clung to by his weeping and broken-hearted countrymen. This picture was one of the chief attractions in the German section of the International Exhibition in Munich last summer.

J. Flüggen seeks his themes in that culminating point of the Renaissance,—the sixteenth century. With the judgment of an artist, and the careful study of an archæologist, every detail of costume and architecture is worked out; severe drawing, and a refined apprehension of the beautiful, and rich colouring added to these qualities, result in the production of such works as "Regina Imhof receiving her Wedding Presents," and the "Baptism of the Emperor Maximilian of Germany," which last was one of the ornaments of the afore-mentioned exhibition in Munich last summer.

Alex. Liezenmayer is widely known as the illustrator of "Faust," and Schiller's "Song of the Bell." M. Adamo paints historical pictures of small dimensions and careful finish. These are all pupils of one master—Piloty. Many well-known names, among the first painters in Munich, are also Lenbach, the portrait-painter; the two Kaulbachs, son and nephew of the late Director; Dietz, Brandt, Benczur, and many others; every possible branch of art being fully and worthily represented.

Munich seems to me to present unusual advantages for art-study to ladies. Although in London and many other places ladies are admitted to study in the Academy and other art training-schools, and, up to a certain point, very much can be learned in these, yet, that part of study which a young man (on the Continent, at least) pursues under the guidance of some special, chosen master, learning from him the more advanced and subtle lessons of his art, is, I believe, in England almost an impossibility for a lady; but in Munich a lady can have all the advantages enjoyed by advanced students in the Academy, *i.e.* by paying for them. Many first-rate artists are willing to visit the lady-students in their own studios, guiding and correcting their work, and assisting their choice and arrangement of subject.

Another great advantage and excellent arrangement are the *copying-room* in the National Museum. On personal application to the Director any article in this most useful and valuable collection (provided it be not of too large dimensions) is brought down into the copying-room, and the artist may bring his picture and lay-figure or model, clothe it in armour or vestment, and work as undisturbed as in his own studio. This is a practical way of solving a somewhat difficult problem, viz. how to make museums of practical utility to artists. Looking at objects crowded together in a glass case, may be, and is, very interesting, but not sufficient to be of practical use. Last year the authorities went even so far as to lend numerous pieces of armour to the artists, to be used at their grand "Waldfeste"; in the costume of the sixteenth century a party of peasants stormed Schwanthaler's miniature castle at Gross-Hesselhohe, which was defended, but in vain, by knights and barons. Then, in the glorious woods on the banks of the impetuous Isar, was held a true artists' festival, in which the *prosa* of the nineteenth century was, for the time, a thing forgotten and ignored.

CHARLOTTE J. WEEKS.

FROM THE BANKS OF THE SEINE.

THERE are, it cannot be denied, *pros* and *cons.* for what we have determined in the present day somewhat inelegantly to designate as the "flat-system," and the objections and advantages can alone be judged of by those who have had peculiar experience of the several systems of flats which exist, and the thoroughly English system of the separate house. The foreigner, accustomed to his suite of apartments, or his "*appartement*," as he calls them collectively, sighs when he has described to him the pleasures of the English home; on his side the Britisher is enchanted with the foreign system, which enables him to occupy comfortably exactly the number of rooms he may require at a comparatively moderate rate. Unfortunately, the comparatively moderate rate is here on the banks of the Seine commencing to become more of a rarity than it was a generation since. Proprietors with the broadening of the streets become more grasping and narrow in their views; with the superior height of their houses, they add to their charges, and Paris, where at one time rent was a consideration which weighed lightly on the purse of the inhabitant, becomes more and more expensive. In vain long lines of five and six storied houses, three blocks deep, rise in every direction along the innumerable new thoroughfares, each house holding literally its dozens of families; the search for a low rent drives masses further and further from the centre. Into that terrible problem of the difference, the existence of which statistics prove, between the number of inhabitants in the city and those who have a roof over their heads, we can scarcely enter, but a few stages above this last degree of misery there are those that suffer almost as keenly. In large communities like those that cluster in the capitals, the problem of these thousands is a hard one for the legislators to settle. In the meantime, the suffering continues, and the provision made for their relief is not forthcoming. We have been irresistibly attracted to the question, one the existence of which is only too well known in our great cities also, by an admirable appeal made in the *Architecte* by an earnest writer, on behalf of the occupants of the innumerable "*petits logements*" which exist in Paris. From a social and political point of view the writer argues that the question should be considered by the Government, and in a warm attack on the grasping proprietor and his minion, the universally detested *concierge* or janitor, some of the iniquities of the situation are skilfully laid before the readers' eyes. The sufferings of the "small lodgers" forced to pay their 300f. or 400f. (12*l.* to 16*l.*) yearly for squalid and unhealthy rooms at the top of high houses, are little imagined but by those familiar with the seamy side of Paris life. The horrors of rent-day, the terrible struggle for the payment *in advance*, the deprivation and the exhaustion from the effort, are pictures which would supply the pen of the artistic writer with powerful and harrowing details, and the brush of the sympathetic painter with sad motives. Lodging, as M. Maret-Leriche urges, is a necessity as important as bread, a political commodity; but the laws which should restrain its feudal liberty have still to be made, and in his eyes their consideration affords one of the phases of the terrible problem of the extinction of misery, and one of the numerous conditions for insuring the steadiness of the social equilibrium. It rests with the architect to prepare these laws; the professional man alone has the necessary and technical knowledge which their elaboration requires. It is impossible not to see the justice of M. Maret-Leriche's appeal. The question of which he speaks is one that has attracted the attention of more than one philanthropist, foremost among whom in this direction merits mention the name of George Peabody. Peabody's example is deserving more general emulation, for the evil of which the French writer complains in his country exists no less on the English side of the British Channel.

With the excellent technical institutions that are now in existence, and where a thorough education is afforded in the various branches of knowledge so necessary to the professional man in the present day, there is every prospect that we shall, before long, see wonders performed by the aid of science and intelligence. Such an institution as, for example, the Zurich Polytechnic School, the annual report of which has recently been submitted to the Swiss Chambers, augurs well for the near future, and we are happy to see that its excellent course of studies is followed not alone by Swiss students, but, among the foreigners, by a number of English and Americans. The programme of studies at the Zurich school is certainly comprehensive; it comprises architecture, civil engineering, mechanics, and industrial chemistry, scientific agriculture and its various branches, and a preparatory course of mathematics. The number of pupils is satisfactory; during last year there were 787; there were more than two hundred foreign students,—Austrians, Germans, Italians, Americans (25), Roumanians and Servians, Russians, Swedes, English (7), Danes, Dutch, French, Greek, and Egyptian. The school possesses laboratories for the study of physics, physiology, analytical, agricultural, and industrial chemistry: workshops for modelling and metallurgy, and a large piece of ground for agricultural experiments: in fact, affords every possible facility for study. English literature forms an important feature in the course of studies, and military drill is also included. Each year there are excursions, in which are visited by various groups the architectural monuments to be found in a certain district, the industrial establishments, sea-ports, engineering enterprises, or agricultural stations. In keeping up this praiseworthy establishment, we are informed by the *République Française*, the Swiss Government, the canton, and town of Zurich all share, each year contributing nearly 400,000 fr. (16,000*l.*). Small as is Switzerland, there are few countries that can boast institutions as admirable as the Polytechnic School of Zurich.

It is in such schools as this that the men of the future will be formed,—such men as the enterprising traveller who has recently earned for himself the title of the "Columbus of the Nineteenth Century," Professor Nordenskjöld, and who during the last week has been reaping here on the banks of the Seine a harvest of golden laurels. The discoveries of the Professor bear only very indirectly on the interests of our readers; but we may mention, from a report on the results of his journey, that the Professor has brought home with him a fine collection of interesting artistic objects,—carved stones, utensils, arms and dresses of the Esquimaux and other Northern people, many of whom, it appears, still make use of muskets with flint-locks. The collection contains also a

number of drawings, engravings, and carvings in ivory, which possess, it appears, much resemblance with some of the early productions of more Southern people; there is also a collection of more than 1,000 works, in 5,000 or 6,000 volumes, of Japanese books and manuscripts, printed and written before the country was opened up to the Europeans. More than half these works contain drawings and cuts which afford much curious information regarding the arts and trades, the ancient customs, the theatres, &c., of the Japanese.

AGREEMENTS AS TO LIGHT.

IT is almost astonishing how new points are continually springing up to elucidate some portions of the law relating to light: one would have been inclined to think that years ago the principle had been fully established; and yet very few sittings of the courts take place without some question arising in regard to this subject,—certainly one of the most important with which in these days the law has to deal. Thus lately, by the case of Bewdley *v.* Atkinson (49 Law Journal Reports, Chancery Division, Appeal, p. 153), we have been given some fresh information upon the ever fertile ground of litigation.

The majority of our readers are probably more or less familiar with the Prescription Act, but to refresh their memory in regard to the particular part which has lately been elucidated, it will be well to quote the third section of this statute. It runs as follows:—"That where the access and use of light to and for any dwelling-house, workshop, or other building, shall have been actually enjoyed therewith for the full period of twenty years without interruption, the right thereto shall be deemed absolute and indefeasible, unless it shall appear that the same was enjoyed by some consent or agreement expressly made or given for that purpose by deed or writing." Such being the law which is applicable, the story, if we may call it such, of the present case was something of this kind,—and it is useful as a practical example of the working of this statute,—

In the year 1814 an agreement was made in writing, and signed by one Isaac Kirkbride, the owner in fee of a house at Whitehaven, who had put out four windows which overlooked the premises of a man named Spencer. This agreement stated that "these windows or lights are put out and remain upon the leave or indulgence of the said Henry Spencer, and that I will, upon the request of him, or his heirs and assigns, to be made at any time hereafter, wall or block up the same, and in the meantime, and until such request is made, as aforesaid, I hereby promise to pay unto the said Henry Spencer, his heirs and assigns, the sum of 6d. yearly, and every year, in consideration of such indulgence." This house was ultimately purchased by the plaintiff's father, with full notice of this agreement, and by operation of nature and law the plaintiff became possessed of this property. Thus we are in the present generation, and a short time ago the defendants, the present owners of the adjoining property, and Spencer's successors, blocked up the windows in question, whereupon the plaintiff came to the courts of law for aid. The plaintiff urged that for more than twenty years these windows had had the full benefit of the light of which they were deprived; whilst, on the other hand, the defendants referred to the agreement as forming the exception to the statutory rule. In all such cases as the present, where there is any element of payment, this, if kept up, is strong evidence that there is no absolute right to the light, and that it is only enjoyed, as this agreement stated, as "an indulgence"; and in this instance payment of the sixpence was proved to a period less than twenty years before the obstruction complained of. But apart from this, there were much more important points involved, because it was urged that it was not a proper agreement in writing within the meaning of the statute, because it was only signed by one party to it. But Lord Justice James very clearly expressed the reason of the statute, which was not to allow such a question as this to be depending on conflicting parole evidence, but to have the arrangement come to shown by a document in writing amounting to an agreement or consent, and obviously, therefore, the agreement in question was one which was supported by this principle. Such an agreement as this would, in fact, be safer without any stipulation for the payment of any nominal sum, because, as Lord Justice James pointed out, if the 6d. is not paid for more than twenty years, this fact might be evidence that, from some cause or other, the bargain was put an end to, whereas, in fact, the non-payment might only arise from the carelessness of some agent who had forgotten to call for so trivial a sum. Hence it is quite possible to imagine a right to light established when the owner of the servient tenement had had no intention to permit the owner of the dominant tenement to have more than the use of the light by his permission; for such an agreement without a sixpence being mentioned in it, to the same effect as that already quoted, would be a perfectly valid agreement, binding on the then owner of the estate and upon all persons who took the ownership of that estate with notice. That, of course, brings us to the exception, namely, that a purchaser of the house without notice would not be bound by the agreement.

The result of the present case, therefore, seems to be to establish pretty definitely what kind of a writing it is which will suffice to defeat the Prescription Act, and will bring a case within the exception provided for in the third section of that statute. And, moreover, on the one hand, it shows that persons who own property should be under no misapprehension as to their right to light; for, no doubt, in the present instance the plaintiff was under the bonâ fide impression that he had an absolute right without any qualification to the light to these windows. On the other hand, the expression of the Lord Justice further serves as a warning against stipulating for any payment in such agreements for leave to have light, or indeed any other easement, because if, by any mischance, such payments should cease, this may, as we have already pointed out, seem to be evidence that the bargain in question is at an end; whereas, if no payment is demanded, the agreement may be kept safely in the family deed-box, to be produced with dramatic effect whenever the latent right is about to be infringed. In this way the owner of the servient tenement seems to be able to preserve his rights with absolute certainty.

THE EMPHASIS OF FUNCTION IN DECORATION.

IN our report of the discussion which followed the reading of a paper at the Royal Institute of British Architects on the "Polychromatic Decoration of Buildings," we mentioned briefly the observations made by Mr. Alfred Tylor, F.G.S. The address of that gentleman, however, was so suggestive and fresh, that many of our readers will thank us for giving it *in extenso*.

Mr. Tylor said: I have lately read a paper on the ornamentation of animals, birds, and butterflies, and I have brought a few explanatory diagrams here with the idea that I could tell you the general laws of decoration I find to prevail in the animal kingdom. I began my paper, at the Anthropological Institute, from the architectural point of view, and used the word *emphasis* particularly, as expressing an enlargement or development of function, and argued that decoration and function should always go together. Mr. Seddon kindly lent me some drawings to prove that *emphasis* was a real thing, and was the key to the laws which govern both Greek and Gothic architecture. Then I had to look at the two great divisions of the animal kingdom, the vertebrata and invertebrata, to see how far *emphasis* prevailed. As an illustration of the vertebral division, the skin of a leopard or a tiger forms the best diagram. I treated the spine as the great function of the vetebral kingdom, because every animal in that kingdom has a vertebral column as its most important part; the darkest spots or decoration of these animals are placed about the central line, distinctly marking the vetebral column. The number of cervical vertebræ (seven) are imitated in the markings of the tiger skin, and the lumbar vertebræ by twenty markings. Each vertebra has a line imitating a rib, and we may call this the axial system of decoration. When you observe the embryo of any vertebral animal, the corpuscles first range themselves in a long line marking out the spine; *that* we may call the principal and upper axis of the animal. Then there are the four minor axes thrown off, marking the position of the four limbs. The colouring and the spots are arranged on each side nearly symmetrically along the principal axis. Then there are sets of spots around the sub-axes, and this is not only true of this particular species, but generally of the whole of the vertebral kingdom; the spots being changed for lines or colour of hair, or muscular development, according to the function to be emphasised. The zebra exhibits series of stripes arranged around the upper or principal axis, around the four sub-axes, the limbs, and around the neck, also around the eyes and ears; there are stripes or rings of dark colour marking the position of nerves, and these lines or stripes radiate from these to the line over the spine. It has been said, I believe, by Mr. Ruskin, that he had found no definite law of colouring in nature, but my inquiries have led me to a contrary opinion. I referred in my lecture to the reptilia. Applying your own word *emphasis*, I state that the serpent is a sort of moving backbone, and the principal function of the animal is emphasised in the decoration. On the neck or head of the snake there are only the simple vertebræ, but as you get to the false rib below these you see that the rib also is imitated. Then, with regard to the invertebrata, take a specimen of one of the Murex family; all the invertebrata grow by borders,—not one has an axial decoration. Each mollusk throws out a piece of new border from time to time, and these great processes are part of the borders, and are analogous to the horns of the deer, which grow only at a particular period of the year; after this the animal adds another piece of border to its mantle, not so pronounced in form or colour. The prominent spines are coloured highly in the direction of their growth, and tipped to contrast them with the flatter parts of the shell. I call this decoration of the invertebrata "marginal," to distinguish it from the axial. There were several eminent naturalists present when my paper was read at the Anthropological Institute; they were acquainted with the specific forms of 20,000 or 30,000 known species, and no one found an exception to the law I deduced, that every invertebrate grows by border, and its decoration is distinctly border or marginate. You see how beautifully the colour has been added, just as you gild the spires and other prominent portions of a building. All the invertebrata have some kind of border ornament. The spots which appear in the Trigonia are projections which are all functional, and now they have become ornamental, showing the close connexion between function and ornament in the animal kingdom. The butterflies and birds are intermediate. The costa is the main rib which carries the main wing; it springs at the thorax, and in every butterfly this is strengthened by colouring or by nervures. In every butterfly there are two or three nervures parallel to the principal, to give emphasis to this part of the butterfly. You have other nervures proceeding to the border. You see how exactly the decoration comes in relation to the nervures. The spots, which are the ornaments, are generally between the nervures, and instead of being by chance they are placed really according to the most rigorous law of emphasis. The decoration of a panther was a simple thing; there was only one piece to decorate. But when you see how small is the body and how large are the wings of the butterfly, it is evident it would have been useless to have expended all the decoration on one little bit,—the central, but not the principal function. The animal has no vertebral column, although it has nerves, and therefore we have a sort of intermediate between axial and "border decoration," as I have called it. There is a good deal to be learnt from correlating art-æsthetics and natural æsthetics. I believe the best bird I am able to exhibit to-night is the peacock, and the decorations of the wings of birds have the same general features as the butterfly. In a bird the radius and ulna come up to a certain point of the upper margin of the wing, where the five fingers are arranged to hold the pinion feathers. I can only give you a very brief outline. Here is an English jay, and another of the Australian species. The middle rib of the feather is decked out with white in one bird, and with black in the other; this is just what an artist would do, he always likes white or black to separate colours. The change can now serve no particular purpose, except that of decoration. You all know the theory about sexual selection, but when you examine the form and colour of every particular bird, you will find a very general law underlying, and that is the law of emphasis. All beautiful shells are entirely covered with a thick epidermis when

alive, and many of their inhabitants have no distinction of sex, and yet they are as beautifully coloured as any birds, and I think that that very much militates against the idea that colour is merely a sexual affair. I believe that ornament was intended to express function, and difference of colour or ornament to imply difference of function, and that you never have function without emphasis, or emphasis without function. Just as the hills in a landscape are sometimes tipped with gold at sunset, the tips of ears or tails, or edges or prominent parts of animals, and also parts of flowers, are often tipped, or differently coloured. In the peacock a small spot near the neck appears surrounded with a copper-colour border, near the crest or neck. Further down the back there is a series of larger spots of the same colour, with fringes added, passing on to the end of the tail. These spots, when the tail of the peacock is expanded, form a kind of glory round the head or body of the bird. This is a most important feature, and is a key to artistic decoration. Every feather is beautiful by itself, and also is a beautiful feature in the whole bird. All the feathers have a local ornamentation, but they have also a general ornamentation, without which æsthetic effect is impossible. Every spot, or stripe, or patch of colour must have a local meaning and a general adaptation. The Moorish Alhambric decoration looks very well on a wall or roof, if the surface is carved all over so as to give a constant light and shade, and afford a pretext or a rationale for the variety of colour placed on the parts, and this was carried out by the Moors. But you cannot put variety of colour on a flat surface, for then it has no meaning. The Alhambric colours and decoration, placed on a flat plaster wall or ceiling, would look very badly. In the same way, good peacock decoration must be a series of overlapping feathers, executed in very low bas-relief, as in the bird. When the same spots, plumes, and colours are placed on a flat wall, not in their order, the good effect of colour is almost lost, that is, the effect on the peacock, as in most other birds, is really produced by general design, and by the play of colour caused by the overlapping edges of feathers of most beautiful shapes. This accords with expression in the human face. The spots have some application to a general design as well as of local beauty. The play of form is lost when the surface is flat, and when there is no general purpose in the design. No trick of colouring can produce a great impression when copies of feathers only from a peacock's tail are placed on a flat surface, such as the wall of a room, or when they are grouped without support from the dado, cornice, ceiling, &c. In modern houses the dado, cornice and central ceiling plaster ornament are almost the only parts that, when decorated, look really well, simply because there are means of putting variety of colour appropriately on a sculptured surface. A uniform surface seems to require a uniform colour. Pictures, of course, have a meaning of their own, and they must be considered as quite apart from mere decoration, which is purely a matter to emphasise function. The advantage of low bas-relief is that colour can be applied in divisions, as in Chinese enamels. The same rules apply to all copies from the animal kingdom. Every ornament in Nature is in accordance with the function it emphasises, and so, if the same ornamentation is transferred to a different function, it must be wrong. The architect ought to be his own art-decorator, and must arrange his designs so as not to make quite a servile copy from Nature. He must, if he attempts natural objects, make each feather, each shell, or each insect stand out from the flat in relief, and have its local value, and yet be part of the general decoration of the hall, or room, or building, and then he may use as bright and as varied colours as are found in Nature, in the peacock, or pheasant, or humming-bird. He must not use axial decoration when only marginal decoration is appropriate, or the reverse. He must not put a series of overlapping fringes of feathers on flat walls without support from the other parts, for that is contrary to the law of emphasis, which strictly requires that function and ornamentation shall go together, and he must in some measure regard symmetry. In Nature unsymmetrical feathers are arranged symmetrically, a perfect harmony of form and colour is produced. I have alluded to Alhambric decoration, but will further mention that an architect of Granada has designed a complete suite of furniture in the Moorish style to suit the decoration of the Alhambra. This was so successful that the Spanish Government employed the architect to furnish the Alcazar at Seville. This is the only palace I have visited where the formation of the building, the structural decoration, and the application of colours to buildings and furniture is all in harmony. It has cost less than other furniture of any other palace in proportion, and differs in this point, that where in most palaces all particular pieces of furniture and ornament are most beautiful, yet they have no general bearing on the whole, and do not perfectly harmonise, and therefore do not produce their full effect, as harmony is absolutely necessary to a true æsthetic effect. This instance proves that the architect who makes the first sketch should bear in mind the final decoration. Of course the latter need not be worked out in full detail. No doubt when the vertebræ and the limbs of the pheasant or peacock are well developed in the embryo, the future brilliant tail is only indicated by a few apparently colourless threads; but no one can doubt that the feathers, which are to form a radiating and circular glory round the head and body of the bird, are contemplated in the design of the complete bird at a very early embryonic stage. And further, it is the architect who must provide not only the structural features to admit of appropriate ornamentation, but he must see them properly carried out under his own direction before he can be said to have properly completed his work. I am very glad that a gentleman so well acquainted with the laws of form and structure as Mr. Seddon, should enlarge on the importance of colorisation and decoration. Function and decoration ought to go together in architecture as in the animal kingdom. I have to acknowledge a debt that naturalists owe to architects: I have applied the architectural law of emphasis to natural history, and hope that natural history will return the application by helping architecture, as far as decoration is concerned.

THE USE OF STEEL IN ARCHITECTURE.

ROYAL INSTITUTE OF BRITISH ARCHITECTS.

At the eighth ordinary meeting of the current session, held on Monday evening last, Mr. J. Whichcord, president, in the chair, Dr. Siemens, F.R.S., was introduced to the members on his attendance for the first time since his election as Honorary Associate. The following gentlemen were balloted for and declared to be duly elected, viz.,—As *Fellows:* Mr. Robert Willey, of Ludgate-hill; and Mr. E. Blakeway l'Anson, M.A., of Laurence Pountney-hill. As *Associates:* Mr. George Ransome, of Queen Anne's-gate; Captain C. F. Blackett (late Rifle Brigade), of Portman-square; and Mr. William Edward Brown, of Chelsea. As *Honorary Associate:* Mr. Conrad William Cooke, of Westminster-chambers.

The President.—Gentlemen, I am sure you will all be very much gratified to hear the news contained in a letter I received a few minutes ago from our respected honorary secretary and past president (Mr. Thomas Henry Wyatt), who, as I have no doubt you are all aware, has been visited with a very serious illness indeed,—so much so that until a recent period he was almost despaired of by his relatives, and it was thought that he would never be amongst us again. I am happy to say I have just received the most cheering news from him; so much so, indeed, that he had hoped to be with us this evening. I am glad to say, however, that prudence has prevailed, and that he has not ventured to come. At the same time, I am sure the announcement I have made will give very great gratification. (These remarks were received with much applause.)

Mr. J. Allanson Picton, F.S.A., then read a paper "On Iron as a Material for Architectural Construction," the substance of which we print elsewhere.

Mr. Alex. W. B. Kennedy, M. Inst. C.E., Professor of Engineering in University College, London, next read a paper on "Mild Steel." To this we will return.

In the discussion which followed,

The President said,—I am sure that the papers we have had to-night will induce an interesting discussion. We have to-night the gratification of the presence of our distinguished Honorary Associate, Dr. Siemens, whose name has appeared before us frequently, and we shall be very pleased to have some remarks from him.

Dr. Siemens, F.R.S., said:—I am sure I can only congratulate you, sir, and the Institute, upon the most interesting and valuable papers to which we have listened. Mr. Picton, in surveying the whole question of the application of iron and steel in architecture, appears to have taken such a broad and enlightened view of the whole question that I should not know what to add. Professor Kennedy has dealt more particularly with steel,—the latest development of iron, as it may be called,—and its preferential merits to iron; and as my name has been connected with one of the processes now largely used for producing this material, it may be expected from me that I should offer a few remarks, chiefly with a view to the properties and the applicabilities of steel for architectural purposes. Steel is a material which, as Professor Kennedy very rightly said, has not been well defined. We give the name of steel to the material of which watch-springs and hard cutting tools, needles, &c., are produced, and which we all know is remarkable for its great hardness, its great elasticity,—or, rather, its high limit of elasticity,—and also for its brittleness the moment that limit is exceeded. Again, we give the name of steel to the material which is now used largely in railway engineering for such purposes as wheel-tires and for the rails upon which they run, and which material is remarkable for great strength coupled with a sufficient degree of toughness to enable it to resist very heavy blows. We also give the name of steel to a material which exceeds even copper in ductility, and which is so remarkable for a quality entirely foreign to the steel of old as to stretch 25 per cent. before breaking. Yet I am in favour of continuing the appellation "steel" in speaking of any of these materials, because they all have this one circumstance in common,—that they have been obtained by complete fusion of the ingredients of which they are produced, and it is from this circumstance that their superior uniformity and the certainty of their character chiefly depend. If we follow the production of wrought metal through all its stages, we all must wonder how it is that such uniformity of strength and character is at all produced as we find it possesses. In puddling iron the workman takes out only about 1 cwt. of metal that has been massed together in a semi-fluid condition, and the nature of which depends quite as much upon his personal skill as upon accidental conditions of heating, the condition of the slag, and other circumstances. Thus one ball is never the same as another ball. One is what is called "younger" and another more matured as it leaves the furnace. These balls are pressed or hammered and afterwards rolled out and separated from the adhering foreign matter, such as cinders, and then worked into shapes such as we require; but the whole mass has never been a homogeneous one. Portions of the metal mixed with cinder are seen to be glued, as it were, to other portions of the metal produced in a similar way; but in looking at a section of the metal through a magnifying glass we see distinctly where they are joined. Whereas, in producing steel, particularly the steel used in engineering and architecture now, we get a perfectly fluid mass, perhaps ten tons of metal, which is tested chemically before it is taken out of the furnace. Before it is run into ingots we test its chemical nature thoroughly, and having satisfied ourselves that we have such a material as is required for our purposes, we deliberately run it into a ladle and from that ladle into ingot moulds; and after that, all we have to do is to give it the particular form or shape required for our purposes. It is, therefore, nothing more than natural that the material so produced should be so much more uniformly trustworthy than the iron of former days. There is, however, still a prejudice,—I cannot call it by any other name,—in the minds of many against the use of this material, because the steel of former days was of an uncertain quality, and occasionally gave way when least expected to do so. Professor Kennedy has sufficiently alluded to the causes why that was so, and I have no doubt that very shortly that prejudice will have been entirely got rid of, and that steel will be used with confidence not only for a great many more purposes than those to which it has yet been applied, but with that confidence which will enable it to be trusted to a higher limit than has been hitherto allowed either by the Board of Trade or by the insuring companies. Among the advantages of steel in architecture I would consider to be the following:—For purposes where boldness and grandeur of outline is essential, no

material can vie with steel. When we want a bridge the third of a mile in span, either a chain-bridge or an arch bridge, there is absolutely no material that can serve our purpose except steel. If iron were to be used in such a structure its own weight would break it down. Therefore, for such purposes, steel must necessarily be used, unless we abandon all idea of such structures. These would be exceptional cases. The more important question, after all, is, How does steel compare with its older rivals, iron and wood, in ordinary construction? Take the construction of an ordinary house. I will venture to say that the use of steel in the construction of houses of ordinary dimensions is not only better and safer, but absolutely cheaper than the use of such a material as wood, and the reasons I will venture to give. In the construction, for instance, of ceilings with steel rafters instead of wood, there is room for comparison. Wood would probably be considerably cheaper in itself than the iron or steel which the architect now-a-days may use; but a steel roof or ceiling would be more permanent, and would be probably six or eight times stronger than the wooden structure with which it would compare. But, granting that steel would be dearer, we should have to bring into our calculation an element which is not at once apparent, viz., that whereas the depth of a ceiling of sufficient strength would be, perhaps, 14 in. if constructed of wood, if constructed of steel a depth of perhaps 9 in. would suffice. If we repeat this saving in depth of floors five times in the height of a house, a total saving in height of about 2 ft. would be the result. Now, in simply squaring the cost of the cubical contents of structure we should find in a house of, say, 60 ft. by 30 ft. (taking the value of the cost of construction of one cubic foot at 1s. 2d.), that we should save in an ordinary house 210*l.*, which would go to the credit of the steel girders. I think that if allowance were made for this advantage it would be found that the iron, and certainly the steel girders, would give the cheapest construction. I may mention here a case which I had to deal with in a small way a year or two ago. I had at my house in the country a terrace, and under that terrace I had a billiard-room. I wanted to lower the terrace 6 in., and at the same time I wanted to raise the roof of my billiard-room, which was low, at least 1 ft. The billiard-room had been constructed according to ordinary rules. There were wooden beams carrying a lead flat with cement and tiles above. I put steel girders over this billiard-room, which was about 20-ft. span, and by filling in between each girder with cement and tiling and lead, I was able to gain 18 in. in height, and obtained a perfectly dry room, whereas before I had considerable difficulty in keeping the water out. This simply shows how, by the use of this stronger material, advantages in convenience and even in cost may be obtained. But it has also been a reproach to iron that it is not "fireproof." I have heard Captain Shaw himself say that he liked a wood-constructed house because he knew exactly when it would give way under the fire, whereas with iron he never knew. Well, there is a great deal of truth, probably, in that remark, based, as it was, upon experience; but I expect that this idea in Captain Shaw's experience has arisen from the use of cast iron. Now cast-iron, I should think, is a very unsafe material to be used in architectural construction. You can never know precisely whether the iron is equally distributed, if it be in the shape of a column or girder,—whether there are not large cavities in the metal that make it unsafe if a fire should break out. Cast-iron, when heated partially, is apt to crack and break, and the Fire Brigade men could never tell when it would give way. But in using steel, a very different condition of things obtains. Steel is a material which has been produced at the highest temperature attained in the practical arts, and it sets at a temperature far exceeding that attained in a burning house; and, therefore, in a structure containing this material for all parts where great strength and solidity are required, it would not be probable that any portion of the material would be heated, in the case of a conflagration, to a temperature sufficient to make it yield on account of that temperature. Unlike cast-iron, steel will certainly deflect,—and deflect to an enormous extent,—before giving way, and thus the Fire Brigade, preferring as they do wood to iron, would probably prefer in a still greater measure to deal with a structure of steel. Moreover, with steel largely used in construction, there is so much less combustible matter for a fire to feed upon and extend, and it is probable that fires in such structures would remain confined within very narrow limits. For columns, instead of cast-iron, steel might, I think, be advantageously used as the mere skeleton, if rolled in a cross shape and surrounded with cement or other material so as to give the structure all the outward appearance of stone while possessing much greater strength. It has been mentioned in Mr. Picton's paper that iron, when applied in architecture, has very frequently been hidden, in order to get its strength. That it can be worked into elegant shapes is proved by the works of Mediæval times; but it appears that the art of working iron into elegant shapes, if not lost, has been abandoned, and the reason why it has been abandoned is probably owing to the circumstance that after the introduction of the blast-furnace, wrought-iron was no longer produced of that high quality which it formerly possessed, and there was a difficulty in working inferior wrought-iron into those forms which we admire in, for instance, some of the old church-gates. By the production of mild steel we are afforded once more a material which is capable, above all others, of being wrought into the most perfect forms. I am sorry I did not think of it this evening, but I will put upon the table at your next meeting a vase of mild steel which has been produced by a very skilful blacksmith out of one bar of steel, and which was presented to me by M. Schneider, of the Creusot works, as a proof of what the material produced in my furnaces is capable. I think it will be admitted by all who see it that for elegance of form and for perfect malleability nothing can exceed this vase. Therefore, we have in this material not only the greatest uniformity and the greatest strength, but we have the utmost security against accident by breakage without giving warning (even when loaded to excess or in the case of fire); and, further, we have in it a material which is capable of being wrought into artistic forms. These qualities combined will, I hope, make it a favourite material in the hands of the architect.

It being by this time a quarter past ten o'clock, the President suggested that it would probably be the wish of the meeting to adjourn the discussion until the next ordinary general meeting, which is fixed for the 24th proximo, and he therefore moved to that effect.

Mr. Charles Barry seconded the motion, and said that Mr. Picton had been good enough, at his (Mr. Barry's) earnest request, to prepare the paper which had been read. Dr. Siemens had at first been asked to submit a paper on steel and its value for constructive purposes, but that gentleman had suggested that the subject should be introduced by a member of the architectural profession. Mr. Picton, who had paid great attention to the subject, was good enough to undertake the task.

Professor Kerr asked why the discussion could not take place next Monday, that being an open night. He thought that when they were obliged to adjourn a discussion, it would be more convenient and much more dignified to hold a special meeting as early as possible, in order to conclude the discussion on a paper. He moved, as an amendment, that a special meeting be held that day week, to continue the discussion.

Mr. Robert Walker seconded the amendment.

Mr. William White said that personally he should have been very glad to be present at the adjourned discussion, and though he did not wish in any way to interpose his own personal convenience, he was sorry to say he should be out of town next Monday.

Mr. Charles Barry said he entirely sympathised with the views of Professor Kerr, but he thought there would be considerable difficulty in carrying them out. The Members of Council and many of the Fellows did their best to arrange their various professional engagements and appointments in such manner as not to interfere with attendance at the meetings of the Institute, which were necessarily pre-arranged and their dates marked in the calendar. He was very much afraid that many members who would like to take part in the discussions would be unable to attend extra special meetings of the kind suggested at a week's notice, especially at this time of the year, when business was usually very pressing.

Only three hands were held up for the amendment, and the motion for the adjournment of the discussion until the 24th of May was, therefore, carried.

ON QUANTITIES AND QUANTITY PRACTICE.*

The amount of detail in the quantities may follow, to some extent, the amount of detail shown in the drawings and specifications. Architects differ very much as to the number and scale of the detail drawings they think necessary for the surveyor, some finishing each drawing into a detail, others contenting themselves with eighth-scale drawings, accompanied by some large-scale drawings, while others, again, think detail drawings superfluous until the work itself requires them in progress. The specifications of different architects vary in like manner, some being laboriously voluminous, and others laconic to an inconvenient degree. These differences have their effect upon the manner in which quantities are to be taken out. As far as pleasure to the surveyor is concerned (and I do not see why the word pleasure should be absent from his professional vocabulary), either a very full and complete specification without detail drawings, or a very carefully-prepared and elaborate set of drawings, accompanied by a terse specification, is the most welcome, and affords a ready means of arriving at absolute accuracy. But if quantities are to be taken out from comparatively incomplete drawings, rendered more obscure by means of a vague specification, the surveyor has to torment the architect with numberless questions, and perhaps in the end has to rely upon his own imagination (a convertible term for a trained perception of the fitness of things) for the solution of mysteries which he should not be called upon to solve. In this way the experience of the quantity-surveyor is often of great value to the architect; and although I have heard it stated that it was at one time the invariable custom for architects to take out their own quantities, many architects now are able to rest upon the judgment of the surveyor as regards many points of construction in the completion of their designs.

It is sometimes necessary for the surveyor to know the interpretation of a phrase in a specification which the individual architect would apply to it, as well as its usual meaning. For instance, a clause may run, "All works are to be done in the best possible manner." This may read in two ways: either "All the works shown or elsewhere specified," or "All the works in the building whether shown or specified or not." A builder would naturally argue for the former construction, and an architect, claiming performance under the latter, might say, "By the best possible manner" I mean "as other works are done which are done in the best possible manner; and I expect you to tongue the skirtings to the floors, splay the bottom rails of the sashes and the beads next them, rebate the meeting-rails of sashes, and splay the edges of doors and the rebates into which they shut, although these things are not specified or shown." The surveyor should be careful to have every ambiguity removed which might otherwise lead to serious misunderstandings and perhaps to his own loss. It is probably in consequence of the fact that ambiguities do exist in drawings and specifications that quantities are sometimes taken with what I should call undue liberality. The time at the disposal of the surveyor may be short, the information furnished him may be meagre, and, in order to make "assurance doubly sure," he may take a more expensive method of the performance of the work indicated instead of a simpler and more economical one such as might have been suggested by the architect upon further consideration. This undue liberality, however, is sometimes so closely connected with want of experience as to appear to proceed from it directly.

It has been publicly stated (and I mention the statement only as a specimen of the extraordinary opinions to be met with upon this point) that it is a common practice for surveyors to take out quantities "full,"—that is, in excess of the actual quantity of material required; and in a paper recently read before a professional society occurs this passage,—"It is, I believe, a common practice for builders to take 5 or even 10 per cent. off the amounts of their bills when moneyed out before sending in their tenders." This statement received no contradiction whatever at the time; but I feel sure that quantity surveyors present will form their own opinions as to its accuracy.

No doubt there are individuals who cannot,

* Paper by Mr. Cecil George Saunders, read before the Institution of Surveyors on the 12th inst. (See p. 490, *ante*.)

under any circumstances, divest themselves of their partisanship, and there may be surveyors who consider it their aim in life to protect the interests of builders; but there is a higher and less unworthy way of performing work of this kind when the surveyor recognises his true functions. He has to deal with facts of the most inelastic kind, and with such facts alone; and it is scarcely possible for him to indulge the spirit of the partisan without incurring the suspicion of dishonesty, in some cases only too justly. But very trivial grounds for suspecting the fairness or competence of the quantity-surveyor are quite sufficient to excite an uneasy feeling in the mind of an employer whose building has cost more than he anticipated, or in that of a builder whose profit has been less than he hoped for. Hence the frequent litigation with regard to the liability of the surveyor for the correctness of his quantities severally to the employer and to the builder.

That the surveyor is liable for accuracy to the builder who pays him is beyond contradiction; but, as will be remembered in a case recently decided, which excited a great deal of interest, it was contended that a surveyor was also legally liable for correctness to the employer. It may be argued that, although the surveyor is paid directly by the builder, yet, as the commission is included in the amount of the tender, he is eventually paid by the employer, and is, therefore, his servant and liable to him. But, on the other hand, any merchant or tradesman supplying goods to the builder for the performance of the contract might equally be deemed liable to the employer for the good quality of the materials so supplied, on the ground that the price of them paid by the builder is equally included in the amount of tender, and if that were the case such liability of the tradesman to the builder would cease. It is, I believe, a principle in law that there can be but two parties to a contract; so that the liability, say, on the part of a timber-merchant for the quality of timber supplied for a building cannot exist both as regards the builder and the employer, because his contract to supply such timber is only with one of them. If the employer bought timber and the builder contracted to work it up and fix it, the liability of the timber-merchant would be to the employer and not to the builder; and, in the same way, if the employer paid the commission for quantities direct, the surveyor would be liable for accuracy to the employer and not to the builder. The moral as distinguished from the legal obligation to supply good timber or correct quantities exists, of course, both with regard to the builder and to the employer; and the application of principles such as I have suggested will, I think, be correct in respect of the subject before us.

In close connexion with the liability of the surveyor for the correctness of his work is the question of liability to the surveyor for his commission. So many and such varying legal decisions have been given upon this point, that one almost shrinks from giving an opinion. Several elements have to be considered, as—How far is the architect justified in employing a surveyor in his client's name, and as his agent? If the architect employs a surveyor, and the building is not proceeded with, is the client liable to the surveyor? If the client is unaware of the employment of a surveyor, is he, therefore, not liable? If he is not only unaware of such employment, but also ignorant of the custom of employing a surveyor, does this ignorance remove his liability? In what cases would the architect become liable to the surveyor instructed by him? If the surveyor be appointed by the builders, and, after the acceptance of a tender, the building is not proceeded with, is the accepted builder liable or the employer? These are some of the varied forms of difficulty which beset the question, but not all, for it will be observed that all the foregoing suggestions are contingent on the supposition that the proposed works are not carried out; whereas similar questions to some extent may be raised with regard to works actually constructed. No doubt some of our Associates, learned in the law, will give us the assistance of their knowledge and experience upon the subject. I believe a case is now pending, in which the work has been proceeded with, and the builder has, as usual, paid the surveyor's commission for the quantities; but the employer now seeks the repayment of that amount to him, as an expense to which he should not be subjected, but which ought to have been paid by the builder without being added to the contract price.

The question whether architects should take out their own quantities is a somewhat delicate one. The author of the passage quoted earlier in this paper with reference to "fulness" in quantities was very much in favour of this system, which has many advantages, as well as many drawbacks. It may be fairly urged that no one can know better than the architect what are his intentions, and that no one, therefore, is so well fitted to take out the quantities. But is it a fact that an architect ever *personally* takes out his own quantities? In the event of his not employing a surveyor, does he not more frequently relegate the functions to a clerk in his own office? And is there not a danger of putting a less liberal construction upon the drawings and specifications before the contract is signed than afterwards? Again, is the artistic faculty of the architect usually found combined with the more prosaic and practical characteristics of the mere measurer?

Another question of importance is the desirability of making the quantities the basis of the contract. This is sometimes done, but the advantages of the system are doubtful; it relieves the surveyor from the necessity of actual and careful accuracy, and it facilitates the introduction of extras, so that the employer is less certain of the amount of his ultimate outlay than should be the case; besides which, the builder might reasonably claim to have the whole of the works measured, treating the quantities simply as a schedule of prices, and thereby increasing the cost of the building by the amount of commission for measuring it. Occasionally, if time be so great an object as that quantities cannot possibly be got out, it may be useful to prepare approximate quantities, treating them as a schedule of prices and basing the contract upon them; but the time so gained would probably be paid for in the increased cost of the building.

It may not be uninteresting to glance at some of the legal decisions which have been given upon the subject of quantities and quantity surveyors. In Kemp *v.* Rose, 1856, it was held, and confirmed in Kimberley *v.* Dick, 1871, that where the architect is to determine the amount due to the builder, and has assured the employer that the cost shall not exceed a certain sum, he does not in the eye of the law possess the unbiassed mind which will enable his decision to be just and conclusive, and the builder may bring a claim for a sum over and above that allowed by the architect. It appears from this that it would be imprudent on the part of an architect to take upon himself the function of determining the amount due to the builder, at least in cases where he has given such an assurance to his client, as he may be leading the latter into a position which he ought not to occupy, and that his better course would be, as agent to his client, to put the winding up of the account into the hands of an independent surveyor.

In the case of McCollen *v.* Kilgallen, 1878, it was decided that, as soon as the contract is accepted, the contractor is under an obligation to pay the surveyor for the quantities, although the commission is to be paid out of the first instalment, and by the abandonment of the job by the contractor, there is no first instalment.

In Moon *v.* The Guardians of the Witney Union, 1837, the questions by whom and for whom the quantities are made out, and who usually pays for doing it, were entered into. The defendants employed to prepare the necessary plans and specifications for erecting a new workhouse, an architect, who employed the plaintiff Moon to take out the quantities. The plaintiff was informed, and all the builders tendering were informed, that the successful competitor would have to pay him. Before any tenders had been sent in, the defendants refused to go on with the work; and as they declined to satisfy the plaintiff's claim for making out the quantities, he brought his action. The defence set up was that there was no contract subsisting between the plaintiff and the defendants.

At the trial, several witnesses, competent to testify on such a subject, proved that the usage was for the builder whose tender was accepted to pay the surveyor. But that the plaintiff should thus be remunerated was rendered impossible by the act of the defendants themselves in countermanding the request for tenders. The jury found that "there was a usage in the trade of architects and builders to have their quantities made out by the surveyors, and the Court held that Kempthorn, the architect, as agent for the defendants, had authority to bind them in such a contract with the plaintiff. They considered that it was a conditional contract,—a contract by which it was arranged that the expenses of making out quantities should be paid for by the successful competitor, if any; but if by the act of the defendants there should be no competition, then that the work which was done by their authority should be paid for by them."

In Taylor *v.* Hall, 1869, it was also held that an architect had implied authority to employ a surveyor to take out quantities by custom, but it appears that the custom must be proved. The judges, however, in the latter case do not seem to have quite agreed upon the sufficiency of the evidence brought forward.

As regards the liability of the quantity surveyor for his accuracy, it would appear that there is no implied warranty, but that in case of incorrectness leading to damage suffered by his employer, an action will lie for negligence and want of skill. But the question who is the employer of the surveyor is apart from this. It would seem that, up to the time of signing the building contract, a contract exists between the employer and the surveyor, but that after that time it ceases as between them, and exists between the builder and the surveyor, so that, in case of the failure of the builder before the signing of the contract, the surveyor would look to the employer for payment, but, if the builder fail after the signing of the contract, the surveyor would prove against his estate.

I have so far endeavoured to bring before the members of the Institution some problems connected with the profession, and shall be indebted for any information which may tend to further elucidate the subject.

ARCHITECTURAL EDUCATION.

GLASGOW ARCHITECTURAL ASSOCIATION.

The opening meeting of the third session of the Glasgow Architectural Association was held at No. 13, Newton-terrace, on the evening of the 13th of April. Mr. John James Burnet, president, occupied the chair; Mr. John Honeyman, and Mr. David Thomson, president of the Architectural Society, were present. The secretary had received apologies from Mr. Campbell Douglas, president of the Glasgow Institute of Architects; from Mr. Robert Greenless, head master, Glasgow School of Arts and Haldane Academy; and from Mr. John Mossman, sculptor, for their unavoidable absence from the meeting.

The chairman, after some preliminary remarks, introduced Mr. Honeyman, who, as hon. president, delivered the customary annual address, after which followed a short address by Mr. Thomson.

Mr. Honeyman then presented the prizes to Mr. Harry Thomson (three guineas for a "Design for a Garden Temple," awarded by Mr. John Mossman), and to Mr. Peter Anderson (two guineas for a "Design for a Small Villa," accompanied by specifications, awarded by Mr. James Sellars, I.A.).

The chief point in the president's address was presented as follows,—

"You cannot hope to undertake such varied work as that admirable society, the London Architectural Association, but in several respects you might profitably follow its lead. I fear you could not manage to have its classes for practical subjects, but I wish to suggest a substitute, and in your circumstances I think an improvement on these, and this, I may say, is the principal point on which I desire to concentrate your attention to-night, and which I ask you to consider and discuss at your leisure. It is this: that every session you should have a course of six lectures on such subjects as these,—1st, foundations; 2nd, the building of walls; 3rd, the roofs; 4th, the floors and partitions; 5th, the proper arrangement of apartments; 6th, the drainage and ventilation. Of course an immense variety of other matters must be mastered by the architectural student, such as the 'History of Architecture,' and its relation to other arts,—to all art, in short,—a vast subject, measuring and estimating, specifications, &c.; besides such practical subjects as plumber-work, plaster-work, slater-work, gas-fitting, bellhanging, painting, &c., but I know you cannot possibly attend lectures on all these subjects in the course of one session. There is no reason why you should not attend six lectures, however, and I believe it will be found that the

six I have just suggested would best prepare you for acquiring a mastery of other subjects, practical and theoretical. Therefore my advice is this, that you should arrange to have a course of lectures on the same subjects delivered to the members every session. I should like much to throw in one or two of the other subjects, but it is impossible; your knowledge of them must depend upon your individual exertions, observations, and study, during your years of pupilage and probation, and with diligence you may thus acquire a sufficient stock to begin with; but on the other subjects you would find the remarks and illustrations of men who have become thoroughly familiar with their details to be of immense value. But, perhaps you ask, do you mean that we are to go hammering away at these same six subjects, in the same order, session after session? Yes, that is exactly what I mean, and I believe you would find this to be extremely interesting and instructive, if, as I advise, each subject were taken up by a different lecturer every session. For example, if you got a lecture from me this session on foundations, in which I detailed the many difficulties which have come under my notice in practice, and the means by which they have been surmounted, I put it to you, if you would not be quite as eager to listen to all that my friend, Mr. Burnet, might be able to tell you on the same subject a year hence? In point of fact, you would listen to Mr. Burnet with more interest than you had listened to me, because you would be better able to understand and appreciate what he had to tell you; and then, if in the course of the following year you had an opportunity of listening to the experiences of our esteemed, and, I may be allowed to say, venerable, friend, Mr. Salmon, I ask you if there is a single member of the association who would willingly be absent when he was to address you? The scheme which I recommend, then, is, briefly, this:—

1. That you should get six of the more experienced members of the profession to lecture to you every winter, each lecturer delivering only one lecture on one of these six subjects in rotation.

2. That at the end of each session an examination on the subjects embraced in the course should take place, and that at least two prizes should be awarded to students who distinguished themselves in these examinations.

Now, if the members of the Association are willing to enter heartily into such a scheme for advancing their professional education, there seems to be only one difficulty in the way of its realisation, namely, the difficulty of securing six suitable lecturers. But I should be sorry to think that such a difficulty really exists; indeed, I have no fear that it does. The burden laid upon each,—the preparation of a single lecture annually,—is exceedingly light, and I think I could name off-hand, at least, a dozen architects in Glasgow, with the necessary qualifications, who would willingly make such a sacrifice in so good a cause. It rests, I think, with yourselves to make such a valuable means of education available."

THE NEW JERUSALEM CHURCH AT BERLIN.

THE capital of the German empire possesses many imposing edifices, but, as regards its churches, they form the weakest point of Berlin architecture. Recently, however, an important step has been taken in order to give proper expression to æsthetic forms in the domain of church architecture. This has been testified in the Jerusalem Church, the restoration of which, in all its parts, including especially the spire, is almost equal to a reconstruction. The superintending architect, Herr Edmund Knoblauch, of Berlin, has created a work which has given general satisfaction. His success must be considered all the greater, as it is a difficult task to re-create a building which has always been an eyesore, while it was extremely inconvenient.

The Jerusalemkirche rises on the triangular space in the south of the city, bounded by the Kochstrasse, the Jerusalemerstrasse, and the Lindenstrasse. The building is designed in such a manner that the tower and the principal portal face south. The cross of the spire marks the orientation, and shows a slight deviation in the direction of the transept of the church.

Jerusalem Church was originally a chapel, "ausserhalb Cölln vor dem Leipziger Thor, und zwar am Wege nach Tempelhof" (outside Cölln before the Leipsiger Thor, namely, on the road to Tempelhof), founded in 1484 by a Berlin patrician named Müller, in commemoration of his pilgrimage to the Holy Land, and his deliverance from the hands of the Saracens. Under the Great Elector, that chapel was enlarged, in 1689, by the architect Simonetti, but even thus increased it was found to be too small. A reconstruction was therefore ordered in 1725, by King Friedrich Wilhelm I., and completed in 1728, the architect being Oberbaudirector Gerlach. The employment of bad materials and the precipitate execution of the work necessitated, after a lapse of only sixteen years, the removal of the wooden superstructure. The provisional square pyramid was finally replaced by the still existing and well-preserved spire erected in 1838 after plans by Schinkel. Four years ago the complete restoration of the church was resolved upon, and the plans drawn up by the architect Edmund Knoblauch were sanctioned by the Government in April, 1878. The work of restoration, including the erection of a new organ, took eighteen months.

The façades of the church are throughout in visible brickwork, terra-cotta being introduced. Without following strictly any style, the architect has selected the forms of the brick architecture of Upper Italy, as well as the Soller-Stüler works, especially the Zionskirche of Baurath Orth. Entering by the principal portal, a richly-decorated vestibule is reached, on one side of which are the stairs to the organ-loft and the steeple, on the other a space which, formerly the sacristy, serves now as a lobby for wedding and christening parties. Entering the church from here, the apse faces us, in which is placed the altar-table, and, above this, the pulpit. Both are of French limestone. The church has been transformed into a long nave by the two exhedræ forming the cross being filled up by galleries supported on columns. The walls and ceiling are covered with interesting frescoes. The seats, of solid carved oak, afford sitting room for 1,366 persons. The church is warmed by means of a heating apparatus placed under the tower.

The organ, constructed by Wilhelm Sauer, of Frankfurt-on-the-Oder, is described as a *chef-d'œuvre*, and forms one of the attractions of the church. It is the 338th organ built by this eminent master.

THE CENTRAL HÔTEL, BERLIN.

ERECTED 1878-1880.

THE influx of visitors to the metropolis of the new German Empire increases from year to year. The annual number conveyed into Berlin by the various railways is estimated at ten millions. The new Metropolitan Railway, which will connect nearly all the eleven Berlin railroads, and over whose lines trains will be despatched to and from the very centre of the city, is a project well calculated to afford innumerable facilities for increased traffic. Of the various stations on this Metropolitan line, the one at the corner of Friedrich and Georgen streets occupies by far the most central and prominent position, and will, in all probability, on that account, be monopolised by the travelling public to the greatest extent.

The erection of a grand hôtel (which in size as well as arrangement deserves to be placed side by side of any of the best hôtels in the world) in the immediate neighbourhood of this Central Railway Station, to and from which 600 to 700 trains will pass daily, may therefore be looked upon as a thoroughly rational and hopeful undertaking.

The new Central Hôtel in Berlin, just now finished, which has been erected by Messrs. Von der Hude & Hennicke, architects (who were also constructors of the now famous Kaiserhof Hôtel where the Earl of Beaconsfield resided during the Congress), is three-sided, being encompassed by Friedrich, Dorotheen, and Georgen streets, and measures 357 ft. by 272 ft. In the basement, spacious kitchens, together with various rooms for culinary and domestic purposes, wine-cellars, and the heating arrangements are to be found; and in the four stories above the lofty ground-floor, 460 hotel rooms, provided with more than 500 beds, are situated. The chambers, which are partly in connexion with elegant saloons, are replete with every comfort of the age.

Especial attention has also been paid to broad and well-lighted corridors, elegant bath and toilet rooms, and practically situated, well-fitted service and servants' rooms.

The sanitary, heating, and ventilating arrangements (to the latter of which much more attention is now paid in Germany than in England, where the necessity is not felt so strongly, owing to the use of open fireplaces), have been executed with every modern improvement by an Englishman of experience, Mr. David Grove, 24, Friedrich-street, Berlin, who is also manufacturing agent for Mr. George Jennings, of London.

Three passenger and luggage lifts, and a number of hydraulic lifts for food (also erected by the above-named firm), and four flights of stairs, form the means of communication between the successive floors, as well as with the reception-rooms on the ground-floor and the housekeeping-rooms in the cellar.

The ground-floor contains upwards of thirty spacious and lofty shops, which face the three streets referred to above, and which also in part (for the convenience of visitors) have direct communications with the central court-yard. The chief entrance for carriages is in the middle front of Friedrich-street, and the drive out only takes place from the Dorotheen-street side of the central court-yard. The entrance-hall is about 131 ft. long, and 26 ft. broad, and in direct proximity with this are situated the three hydraulic passenger and luggage lifts, toilet-rooms (as fitted in England), porters' rooms, hotel, post and telegraph offices, and, above all, the marble staircase.

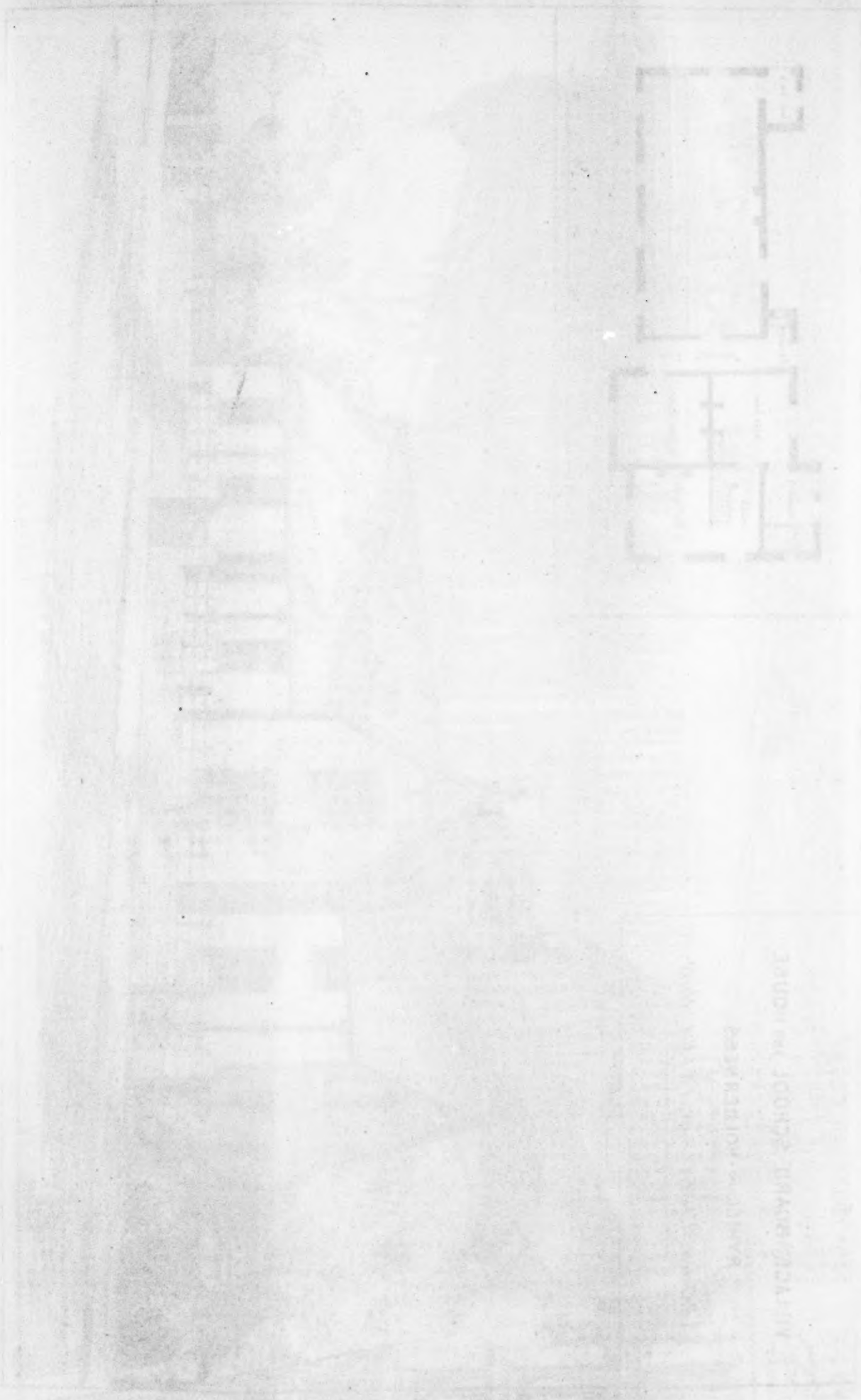
From the entrance-hall (after passing through the ante-saloon) the visitor enters three large saloons, which serve respectively as luncheon, dining, reading, and, if required, as festival saloons. If necessary, they can be converted into one large saloon, 197 ft. long, 36 ft. broad, and 28 ft. high. Ladies' saloons, wardrobes, toilet-rooms, ante-chambers, terraces, and spacious serving-rooms communicate with these magnificent saloons, either of which may be used for private purposes, dinners, balls, and so forth. The saloons are richly decorated with ornamental and landscape paintings; the walls are executed in stucco marble.

In proximity to the saloons, on the ground-floor is a large winter-garden, 246 ft. long, 75 ft. broad, and 56 ft. in height, surmounted by a glass cupola. The winter-garden, which has been carried out in a rich Renaissance style, contains palms and a great variety of plants, ornamental statues, fountains, and seats, and being well heated, ventilated, and illumined bright as day by means of five sun-burners and a large number of gas-lamps by the above-named firm, it offers to guests, as well as to the Berlinese, an exceedingly agreeable resort. The chief entrance to this magnificent pleasure-garden, to the vestibules, offices, wardrobes, and the drives in and out, is in Dorotheen-street; the *café restaurant*, which is also in direct communication with the garden, opens towards the railway side (Georgen-street), so that newly-arrived guests or the travelling public may at once obtain refreshments,—no refreshment-room having been fitted up in the railway station for want of space. In addition to the above, post and telegraph offices, as well as offices for the sale of railway and theatre tickets, are to be found on the ground-floor.

The façade in Friedrich-street is flanked by two cupola-finished structures, 98 ft. high. A porch, with pillars and pediments above, in the centre of the same side, is a good specimen of architectural and sculptural art. Each of the eighty-eight windows and window-doors on the first-floor is provided with a richly-gilded wrought-iron balcon. A frieze of gold mosaic-work from Dr. Salviati, of Venice, passes underneath the windows of the second-floor, into which are worked the names of all the most important cities of the world in garlands of fruits and flowers. The large central court-yard, 95 ft. long and 63 ft. broad, is decorated with terraces, balcons, fountains, and a rich supply of gas-brackets.

Owing to its excellent position near the "Linden,"—the central and most fashionable part of Berlin,—its proximity to the chief metropolitan railway station and the tramways, as well as on account of its extensive and complete arrangements, the Central Hôtel, as a first-class establishment, is not only an ornament to Berlin, but will also be found an exceedingly cheerful and attractive residence, in which the stranger will be enabled to enjoy Continental life combined with the comforts of an English home.

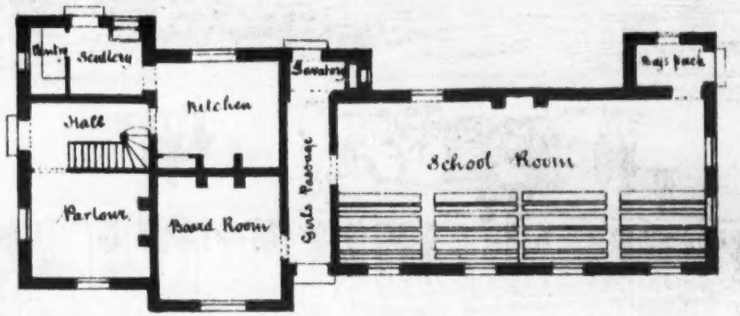
THE JERUSALEM CHURCH, BERLIN, AS RESTORED.—HERR EDMUND KNOBLAUCH, ARCHITECT.



VILLAGE BOARD-SCHOOL AND HOUSE

RYHILL-IN-HOLDERNESS

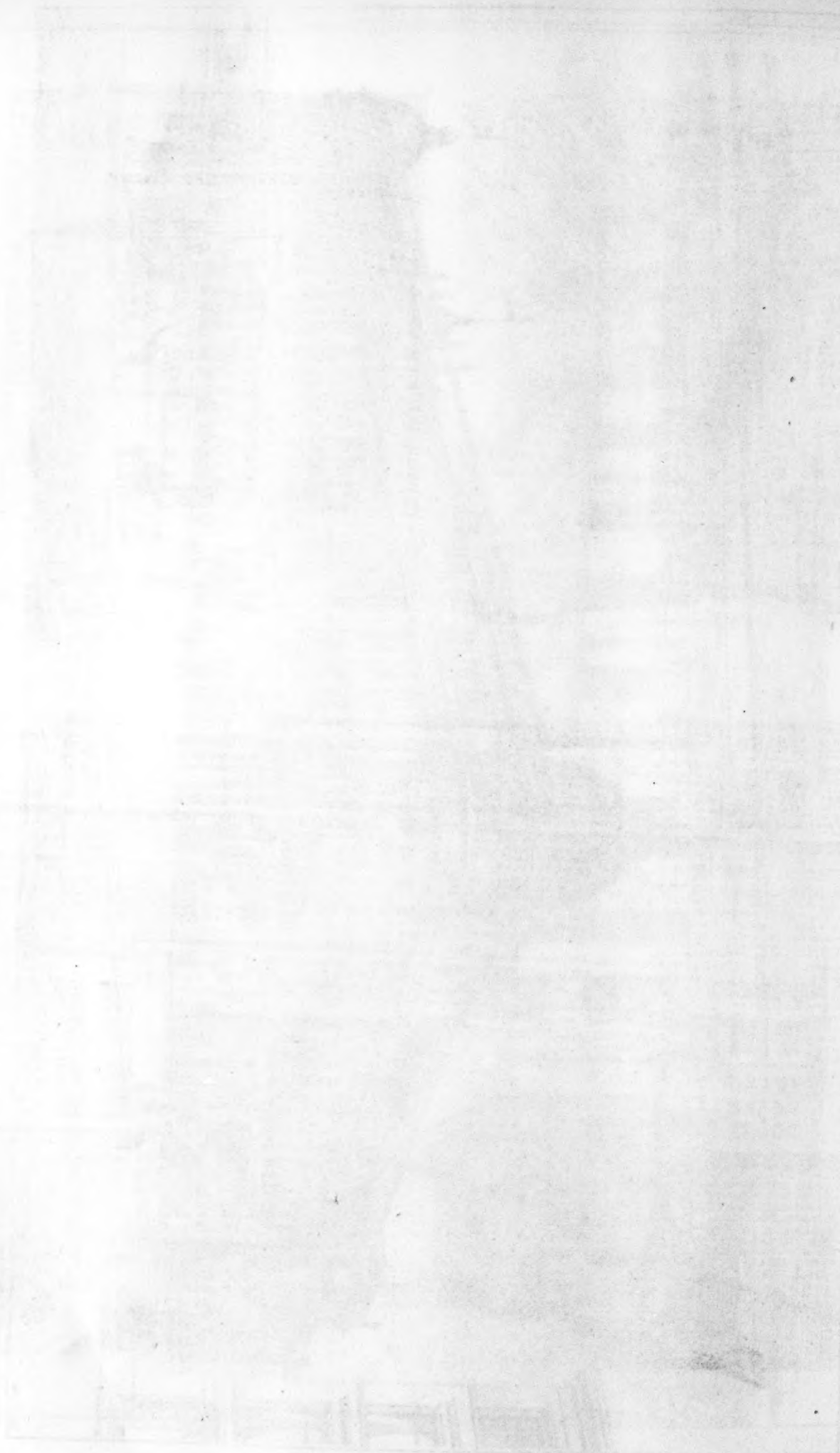
Architect, Robert Clamp, A.R.I.B.A. Hull.

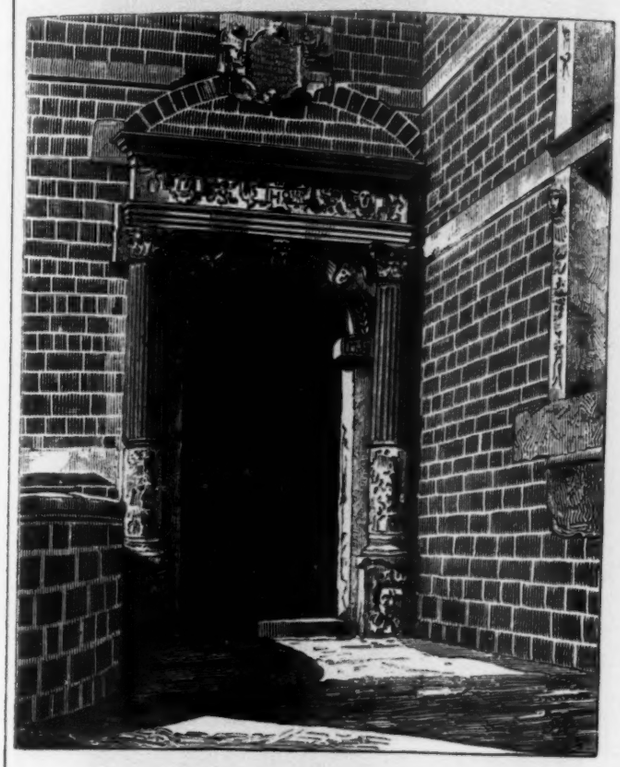


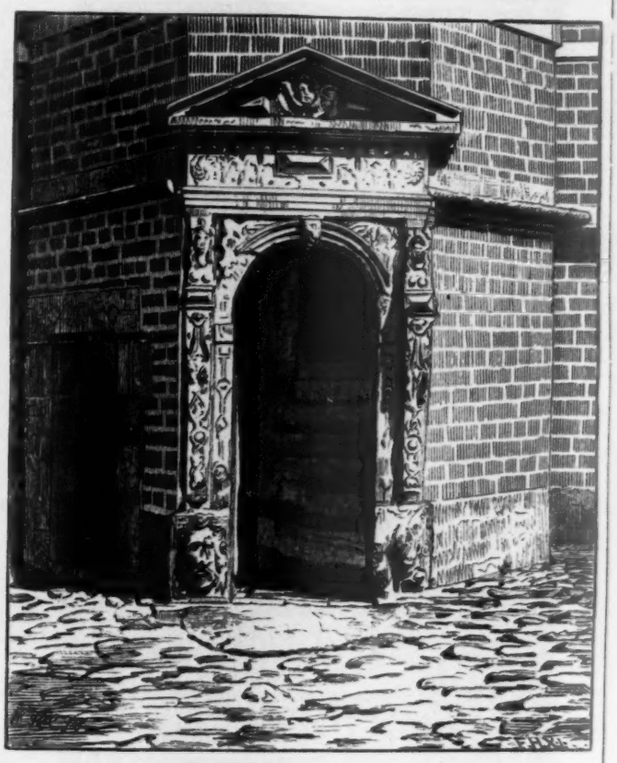
Whiteman & Bass *Photo Litho* 236 High Holborn

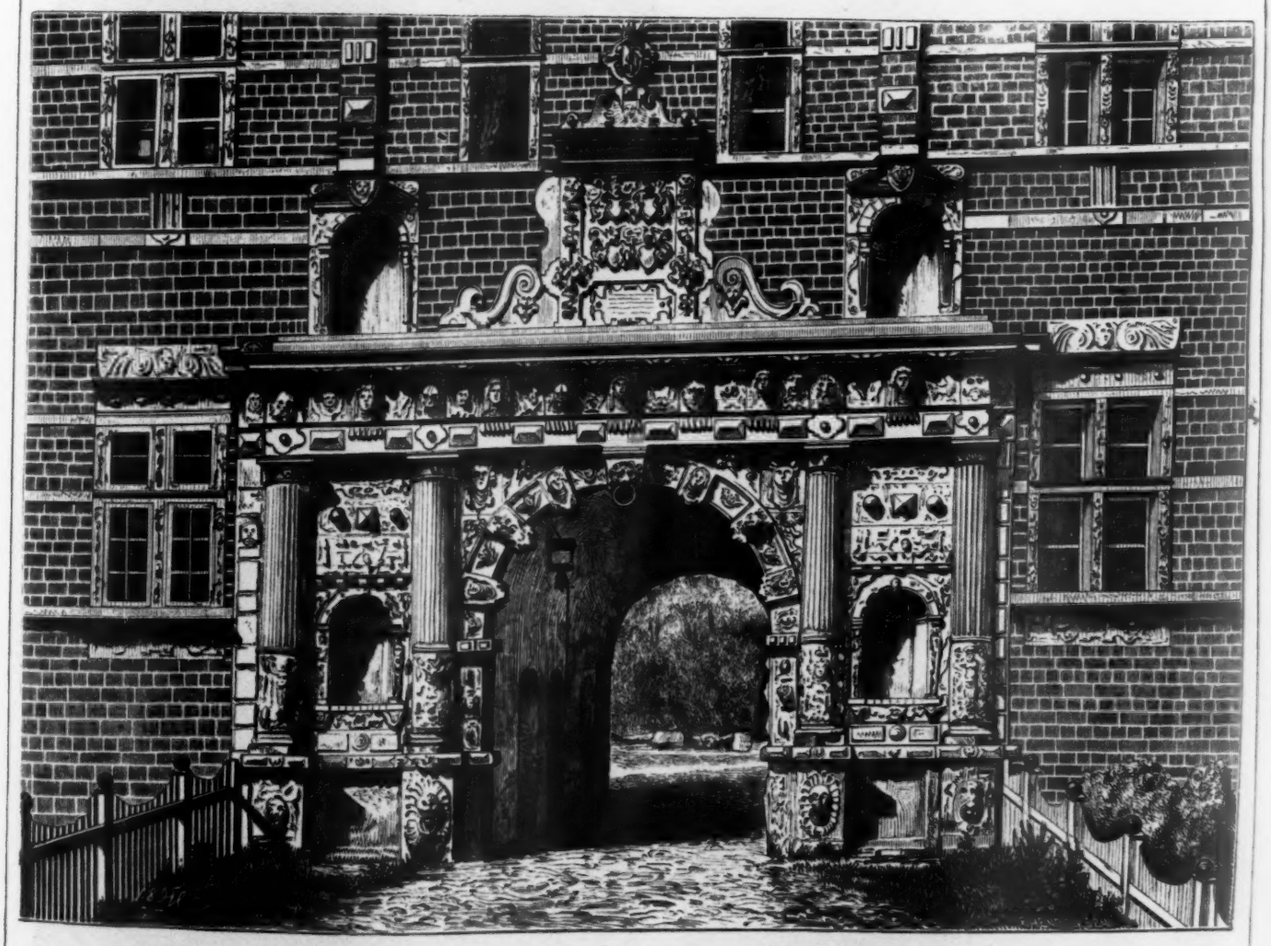
Printed by Wyman & Sons

THE NEW CENTRAL HOTEL, BERLIN.—MESSRS. VON DER HUDE AND HENNICKE, ARCHITECTS.









A NORTHERN MANOR HOUSE.—Dutch Renaissance, Sixteenth Century.

A NORTHERN MANOR HOUSE.—Mr. Thomas Dickinson, Architect.

FIG. 1.

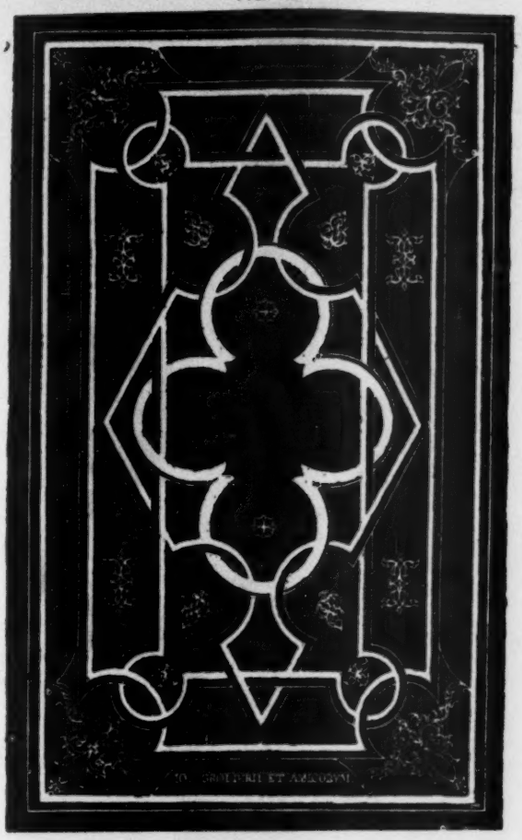


FIG. 2.

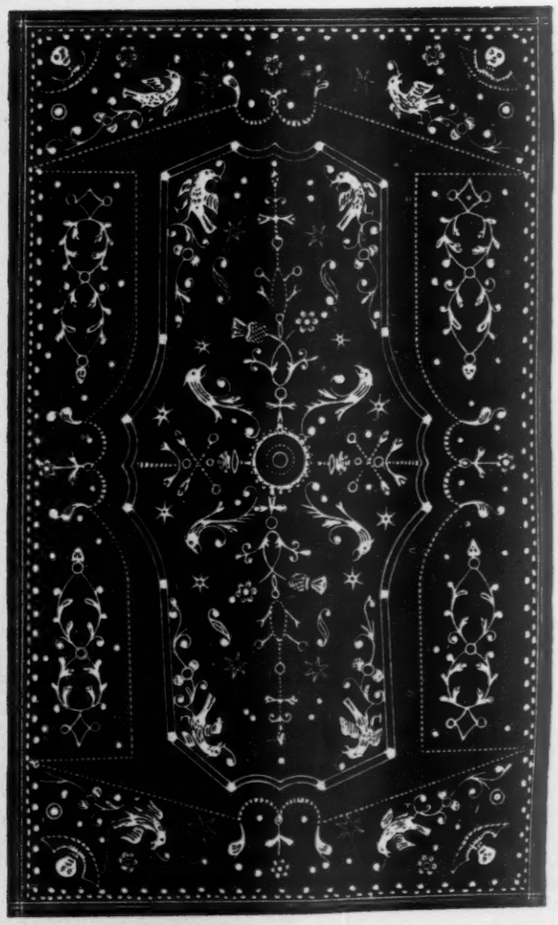
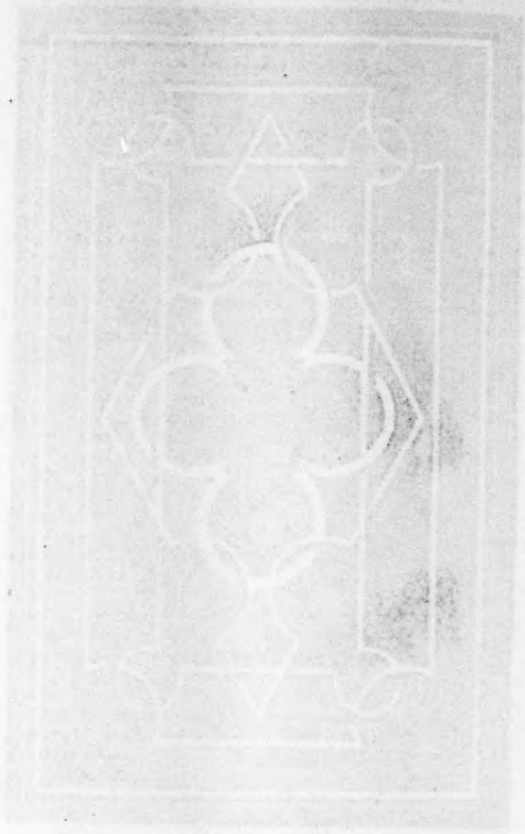
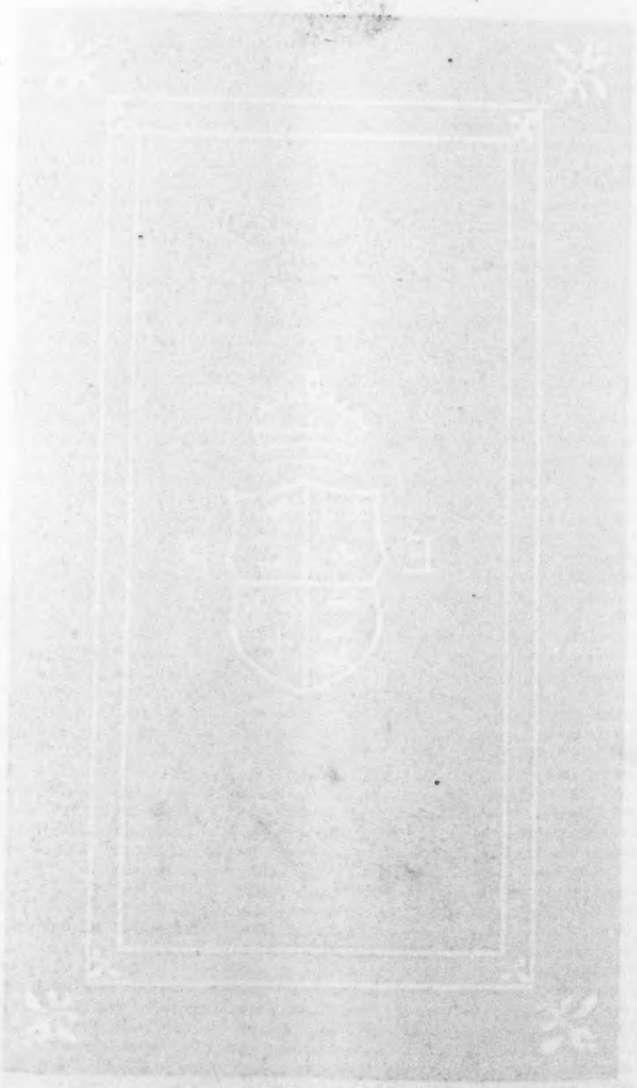


FIG. 4. FIG. 3.

BOOKBINDING AS AN ART AND A MANUFACTURE.—In Illustration of Mr. Wheatley's Paper.





BOARD SCHOOL, RYHILL-IN-HOLDERNESS.

This building comprises a mixed school for the accommodation of seventy-two children, having separate entrances for boys and girls; a board-room; and a residence, containing the usual accommodation, for the teacher.

The accompanying plan shows the general arrangement, which includes a lavatory at the end of the girls' passage, with water-trough and pump over, for the use of the scholars.

There are three bedrooms on the upper floor, and the materials of construction are red brick, with a little stonework for cills and dressings, and an open-timbered roof covered with slates. The design is characteristic, although of simple type, economy having been a consideration. Mr. Clamp, of Hull, is the architect.

A NORTHERN MANOR HOUSE.

VENDSYSSEL, DENMARK.

The old manor-house of Voergaard, in Vendsyssel, Denmark, of which we give views in this issue, is a specimen of an early Northern manor-house which is almost unique. The building has been altered, but the principal external features have been preserved.

The main building of Voergaard was erected by Lady Ingeborg Skeel, between the years 1586 and 1591, being inaugurated on March 10th of the latter year. It was, however, far from completed. At any rate, the present appearance of the manor-house cannot have been in accordance with that lady's intention, as will presently be seen.

Voergaard is erected in the Dutch Renaissance style. The architect's name is unknown, but it is evident that the ornamentations in sandstone have been carved elsewhere, which is seen, for instance, by those of the portal having been extended into those round the two nearest windows, making it necessary to cut off part of them. There has evidently been some blundering in measurement, and the lady has not been able to find sufficiently skilful workmen to amend the mistake made. The fact of some of the ornamentation having been put up damaged points to the probability that the stones were broken in transport, and that it was found afterwards impossible to get workmen to repair them, or to put in new ones. Further evidence of foreign workmanship are the meaningless inscriptions over the portal and chief entrance.

The inscription on a monument in memory of Lady Ingeborg's parents and brother, in the chapel of Voergaard, for instance, is entirely unintelligible, and there are also mistakes in the respective coats-of-arms.

The main building of Voergaard has at each corner of the façade a heavy octagon tower of the same elevation as the building itself. On the side toward the courtyard there are two staircase-towers, which rise a story higher. The walls of the house are of red brick, relieved by courses of grey sandstone. The window-frames, portal, and the two entrances are also of that material. The bands of sandstone extend along the flat walls, and continue between the corners, which are ornamented by pilasters of masonry that in the corner towers extend to the ground, and rest upon corner-stones, ornamented with masks, heads, or flat ornaments. The pilasters are decorated with rustic work in sandstone. In agreement with the corner stones a heavy band of sandstone extends under the windows of the first story, and beneath each window there is a broad band, with flat ornamentations. The triglyphs are also of sandstone.

All the window-frames are square, and the flat sides are ornamented with fruit, festoons, figures, &c., in relief. Over the windows are masks and heads. The windows in the gables are somewhat plainer, and without ornamentation on the frames. The windows are surmounted by ornamental pediment heads.

The airholes in the cellars form grim embrasures, lined with sandstone. The doors of the staircase towers, of which we give views, are also set in sandstone frames. The date, 1738, on a stone at the door, shows that repairs were executed during that year.

The chief portal is very ornamental, and reaches up to the first story. Four quasi-Doric half-columns, between which is the semicircular entrance and two niches, support an ornamental architrave, the flat sides being richly decorated with fruit, masks, and cartouches. The triglyphs have masks and heads in relief, and the metopes cartouches. The cornice is supported by corner-stones and heads of angels. Above the cornice is a decoration with inscription and shields with coats-of-arms; on each side of it is a niche. In the niches shield-bearers have probably stood. The Doric pillars are fluted in the upper part, and richly carved below, the pedestal being ornamented with lions' masks, and on the whole of this bizarre decoration are the initials F. S., with a crown above,—Fredericus Secundus. On the portal is the date 1588.

The portico has beautiful arches. Towards the courtyard is a simple portal with half-columns of masonry decorated with rustic-work in sandstone. The half-pillars of the small portal to the staircase tower in the corner have Corinthian capitals. This is the only place where the latter are found, but probably they would have been put on the topmost pilasters of the gables, where, as elsewhere in the building, the pilasters in the first story belong to the Doric, and those in the second story to the Ionic order.

As already observed, it does not appear as if the building had been completed according to the original design. Although everything else is in the Dutch Renaissance style, the gables, which are generally the most prominent features in buildings of that class, are almost devoid of ornamentation. The original buildings have either never been completed, or else they were partly destroyed in the wars with Sweden.

The decoration of the end walls gives us an idea of Lady Ingeborg's plans. The bands of sandstone cease where the upper story of the corner turrets would commence, and inside the attics a good deal of masonry for the upper story can be seen.

Excepting the gables and corner turrets, the roofing, and the modern windows, the building is in the same state as it probably was three hundred years ago. The sandstone decoration is, of course, worn by wind and weather, but the details still show traces of good execution.

The interior of Voergaard does not correspond with its antiquated exterior features. Nothing of the interior of the rooms as arranged by Lady Ingeborg's probable instructions now remains. Everything is changed and modernised. The arched cellars and the old chimneys, however, form an exception. It is by them that we are still able to guess how the rooms were originally arranged.

The entrance-door in the staircase tower gives access by a spiral staircase to the second floor and the attic. On the right, a heavy door, carved in oak, leads into a large room in four compartments, which is 22 ft. by 14 ft., by a height of 14 ft. It is next to the gate, and on that side there has been a large stove, the floor being paved with stone slabs. The beams are visible, and are painted with leaf ornaments. From this large room, doors lead to the wing and to the gable room. This latter, which is 8 ft. by 14 ft., opens into the corner tower, with a room 10 ft. by 10 ft. Upstairs there is the same division of rooms, but they are only 12 ft. 6 in. high. There are still remnants of the old decorations in the large room, where there is also at one end a great stove.

A WELL-EARNED REWARD.

We hear with great pleasure that H.M. the Queen has granted a pension of 150l. to Mr. S. C. Hall, "in recognition of his long and great services to art and literature." The value of the boon is greatly enhanced by the fact, as we learn on what seems good authority, that it was a spontaneous act on the part of her Majesty. Things have greatly changed since Mr. Hall founded and produced the *Art-Journal*, now, if we remember rightly, nearly forty years ago. At that time there was no public for such a publication, and readers had to be educated up to it. This, moreover, is not the only medium through which during long years Mr. Hall has done his duty to the State.

National Health Society.—The course of drawing-room lectures to commence in May will include the names of Dr. W. B. Carpenter, F.R.S., "Predisposing Causes of Disease"; Dr. Samuel Wilks, F.R.S., "Hysterics"; Professor E. Ray Lankester, "Unseen Enemies,—Germs"; Dr. Walter Moxon, "Evils of Competitive Examinations"; and Mr. Ernest Hart, "The Doctor in the Kitchen."

BOOKBINDING AS AN ART AND A MANUFACTURE.

Mr. H. B. Wheatley, the assistant secretary of the Society of Arts, at a meeting of the Society on the 14th inst., read a paper on the History and Art of Bookbinding, which was very completely illustrated by examples. Mr. George Bullen, F.S.A., the esteemed keeper of the printed book department in the British Museum, presided, and the discussion which followed included some valuable observations from well-known experts. Omitting the historical portion of the paper, we print those parts of it which relate to bookbinding as an art and a manufacture:—

BOOKBINDING AS A FINE ART.

I now pass on to consider bookbinding as a fine art, and here I feel that I am treading upon dangerous ground, and walking without a guide. All agree that binding should take rank among the decorative arts, but I do not find that any principles have been evolved for the guidance of the binder, or that any definite indication of the points of its connexion with or divergence from other arts has been satisfactorily set forth. De Quincey, in alluding to the choice of the trade of bookbinding by the Ferrars, writes:—"Why this was a good trade to choose, I will explain in a brief digression. It is a reason which applies only to three other trades, viz., to coining, to printing books, and to making gold or silver plate. And the reason is this,—all the four arts stand on an isthmus, connecting them, on one side, with the vast continent of merely mechanical arts; on the other side, with the far smaller continent of fine arts."* This is true in a double sense, for in one point of view, every good binder who tries to work out an idea is an artist, whether the result is plain or ornamental; and, in another, the finished side of some richly-tooled book is as much a work of art as any picture or drawing.

Clearly, all books should be kept in good condition, and we cannot but approve of the conduct of the King Alphonsus, of whom Peacham (English Gentleman) tells the story that, when "about to lay the foundation of a castle at Naples, he called for Vitruvius, his book of architecture. The book was brought in very bad case, all dustie, and without cover, which the king observing, said,—'He that must cover us all, must not goe uncovered himselfe.' He then commanded the booke to bee fairly bound and brought unto him." Locke loved a handsomely-bound book, and wrote to his friend Anthony Collins, in 1704:—"I beg the favour of you to get me Le Clero's 'Harmony,' bound very finely in calf, gilt, and lettered on the back and gilt on the leaves. . . . . I like to have things . . handsomely made, and fitly adapted to their uses. If either were necessary, I had rather be taken notice of for something that is fashionably gaudy, than ridiculously uncouth." Some think this is an extravagance, but Roscoe pertinently remarks, in his "Life of Lorenzo de Medici":—"It is difficult to discover why a favourite book should not be as proper an object of elegant ornamentation as the head of a cane, the hilt of a sword, or the latchet of a shoe."

The man who is particular about his bindings will often be in a state of fear and trembling when those who do not understand books attempt to handle his treasures. It is related that the Superintendent Fouquet had a pile of white gloves in the ante-room of his library, and no one was allowed to proceed further until duly provided with a pair, lest the books within should receive a soil from the naked hand.

I think we may safely say that binding, to be a fine art, must be the outcome of an honest and original attempt to adapt beautiful forms to the special purpose of adorning a book. Moreover, appropriateness must be the binder's guiding principle; for, however beautiful the design may be, it becomes bad art when applied to a purpose for which it is unsuited. Pictures or drawings are beautiful in themselves, and the responsibility of placing them in a good position lies with the hanger; but the picture on the side of a book must correspond with the subject of the book, and with the colour and material of the cover upon which it is worked. Old bindings have one immense advantage over modern ones in the mellowness of the gilding, which time only can give; but we should not be seduced by this into admiring bad art, for it must be allowed that all the elaborately-gilded

* Works, vol. vi., page 249.

bindings of past times are not necessarily in good taste.

There are three totally separate styles of art to be distinguished in the history of bookbinding, and each one appears to have been uninfluenced by the others. These are exhibited in (1) the old stamped leather, which was brought to perfection by the Germans; (2) the gilt tooling, which came to us from Italy; and (3) the blocked covers of modern cloth bindings.

1. In the first instance, the ornaments on the leather were of the simplest description, and merely intended to hide the bareness of the side. Afterwards, an elegant artistic taste came into play, and many of the stamped calf, vellum, and pigskin covers became,—thanks to the designers of the blocks,—marvels of delicate treatment. A considerable variety of design was indulged in, and portraits and other illustrations of the contents of a book were often stamped upon its cover. All this ornamentation was blind work, and the scrolls, and flowers, and mottoes were only shown by their slightly-elevated surface over the rest of the cover.

2. The gorgeous gold tooling which flourished for many years, and gradually drove blind tooling out of fashion, came to us from Italy; but there is no doubt that it had an Eastern origin. Some of the earliest Italian ornamental bindings are evident imitations of the covers of Persian and Arabic MSS. There were two styles which were more particularly copied, viz., the corded and dotted patterns, and those in which large surfaces of solid goldwork were spread over the side. There was, I think, another influence at work in the formation of a highly ornamental style, and this was the old chased silver coverings, which were evidently imitated in some of the elaborate designs in leather.

3. The artistic effect of some of the best cloth covers is very remarkable, and this is due to the employment of first-rate designers, whose aim is to produce a binding appropriate to the subject of the book. There is one point of especial interest in respect to cloth binding, and that is that we can claim the art as entirely an English one. I need not say more here on this subject, as I have still to add a few words on cloth binding, under the heading of "Bookbinding as a Manufacture"; but I will just remark on the point that, in the production of the earliest and latest classes of binding, block stamps have been used.

I have already referred to the first of these divisions, and will now treat more particularly of the second.

Maioli and Grolier were friendly rivals in the patronage of bookbinding, and both of these worthies adopted the geometrical patterns that so soon spread over the whole of Europe. These patterns became popular in England in Edward VI.'s reign, and elaborate designs were very generally adopted here. It is a question that has yet to be proved whether this work was done by Englishmen, or whether foreigners were brought over to supply materials for the refined taste of the upper classes. Grolier appears to have taken Italian workmen with him on his return to France, to teach his countrymen the elaborate art. They were apt scholars, and, as time passed on, taste in binding decayed in Italy, and made its permanent home in France. We speak of the Grolier style, but the number of styles which this magnificent patron of the art introduced is legion. First, there are the somewhat stiff geometrical patterns; then the more easily linked ones; and, lastly, those in which some flowery ornament is added. Fig. 1 is a good specimen of this last.* Grolier appears to have been always anxious to improve upon his patterns. Sometimes the results were scarcely satisfactory, and I venture to think that the architectural designs upon some of his books are inappropriate.

After the death of Grolier, the binders eliminated the geometrical forms more and more, and replaced them with representations of flowing leaves and boughs of trees. Nicholas and Clovis Eve obtained very beautiful effects by a quite novel treatment of foliage, and also by an elegant repetition of special objects. New conditions were submitted to these binders, and they surmounted the difficulties of arrangement with consummate taste. Grolier and Maioli very occasionally introduced arms into their bindings, but the binders employed by the royal family of France had to make arms, monograms, *fleurs de lys*, and many other devices the main features of their designs. What splendid effects they obtained by the judicious mixture and repetition of these ornaments is known to all who are familiar with the triumphs of the French bibliopegistic art. The Eves were almost the only binders who succeeded in making the two sides of a book and its back the three parts of one congruous whole. The backs are without bands, and the square lettering is in pleasing contrast to the flowing beauty of the ornament.

Le Gascon and Dusseuil were the producers of much artistic work. Padeloup and De Rome did not bind so elaborately as their predecessors, but their work is of a distinguished character. De Rome was famous for his gilt borders.

Roger Payne was a true artist, and his dominant idea was the adoption of ornament appropriate to the character of the book. This is apparent from the wording of his bills, as he was able to give reasons for the adoption of his various designs. His backs were usually fully gilt, but his sides were seldom ornate. In most cases, he confined his tooling to the corners. It must be allowed that, although Roger Payne was the most celebrated of English binders, he was not equal to the great French binders. It is, however, a remarkable proof of the excellence of English bookbinding in the last century, that a series of annuals, such as Rider's almanacs, should have been for more than 100 years elaborately bound in red morocco, with a constant change of design. Fig. 3 is taken from one of the year 1752, and I have seen others still more beautiful. A particular style of binding, called the Etruscan, was introduced by John Whitaker, in which designs from Etruscan vases were copied in their proper colours, instead of in gold tooling. This fashion had considerable vogue for a time.

At the period of the Revolution, art died completely in the hands of the French bookbinders, and, when there was an attempt to revive it, the eyes of France were turned towards England for inspiration; but the French binders long suffered from the difficulty of obtaining a good morocco. The English binders were not, however, sufficiently artistic to be able to retain this influence, and the French again took the lead by studying the works of their own masters. In the earlier ornamental binding, effects of colour were largely obtained by adding a thickish paint to the leather, and inlaying was not a general practice. In the last century, it became more common, and now it is a distinguishing characteristic of the French binding. It has very frequently been felt by men of taste that the ordinary marbled papers, when used as linings, were in too violent contrast with the richly-gilt sides, and various attempts have been made to obviate this objection by the use of silk and other ornamental materials. The French binders introduced a system of lining the inside cover with leather, which was sometimes also richly gilt; this is technically called *doubl*. This practice was adopted in the East at a very early period, and I have seen a Persian MS. of the fifteenth century with a highly ornamental leather lining inside, so that the French only transplanted to Europe what had long been common where so much of one art had its first home. I venture to think that this practice is inappropriate, and in bad taste, as it answers no useful purpose. I put forward this opinion, however, with some diffidence, as I believe that I am in a minority. The French binder, M. Trautz-Bauzonnet, who died lately, was a great master in the art of inlaying, and his works are highly appreciated by connoisseurs. At a late sale in Paris, a book of no very great value, bound by him in his best and most elaborate style, sold for 640*l*. By no possibility could the book itself have been valued at more than between one and two hundred pounds; so that at least 440*l*. was given for the binding alone. It was considered as a work of art like a picture or a piece of china that could not be replaced, and fetched a high price accordingly. I should like to make this incident a text for the few final remarks on the point we are now discussing, because it brings out very strongly the difference in the estimation of binding here and in France.

I fear that we must answer the question, Is bookbinding a living fine art? in the negative, because the greater part of the work now produced is imitative, and imitation always leads to the death of art. Then comes the further question, Can the art be revived? Surely it might be, if the true principles upon which it is founded are mastered. As artists, such as Holbein, Petit Bernard, and many others, have given designs to the bookbinder, so the artists of the present day might do the same. But the designs must be specially adapted for the purpose for which they are intended, and should, in many cases, be indications for the guidance of the artist-binder rather than finished drawings. Binders are particularly liable to the difficulty of not knowing exactly where to stop. They may add to an already beautiful design, and spoil it in the process. It is, however, hopeless to expect the art to revive until some means are taken to raise the standard of appreciation in which binding is here held. There are now few connoisseurs who understand the principles of artistic binding, and many men and women, who would be ashamed to admire a bad picture, will admire a gaudily-bound book by an inferior workman.

Why does binding flourish more in France than in England? The natural answer is, because abroad there are more collectors who possess small cabinets of well-bound books. It has been remarked that, in spite of our boasted culture, few houses of well-to-do persons contain any handsome books. Now, most of us have one or two favourite authors. The works of these should be possessed in the best editions and the handsomest covers. Other books might be ordinarily clothed, but those which the owner delights to honour should have ornament lavished upon them. If this feeling became general, we should soon see a revival in the art of bookbinding; but I must add one caution. Good binding will always be expensive, because it takes much of the time of a good workman. The lover of binding, therefore, must not grudge the price, or, if he does, he will not get good work.

BINDING AS A MECHANICAL ART.

In treating of bookbinding as a fine art, I have alluded to the comparative state of decadence into which it has fallen at present; but, now that I come to consider binding as a mechanical art, it is necessary to state that never was that in a higher state of perfection than at present. Much of the old binding is a marvel of strength; but it is also clumsy. The wooden boards, with leather bands, or thongs, wedged into the holes made for them, with wooden wedges, give the book they cover the appearance of pieces of furniture. Petrarch found out the dangerous massiveness of these books when he dropped his own transcription of Cicero's "Epistles" upon his leg, which he injured so much as to narrowly escape amputation. In some specimens of ornamental tooling, the lines are not always straight, and they often do not join as they ought. Moreover, many books, the covers of which are marvels of artistic treatment, exhibit a certain rigidity about the joints. None of these flaws are to be found in good work of the present day, which is usually perfect from a mechanical point of view. The aim of the binder for many years has been to unite strength and elegance; and there are morocco bindings which will probably outlast the books they cover. The binder, to be successful, must have an artistic eye, and nearly all his work must be done by hand. Few trades have been less able to avail themselves of machinery than his; so that a picture of the Middle Ages, showing a binder at his work, differs little in detail from what may now be seen in any shop in London; the same hammer and the same sewing-press are exhibited in both. The cost of binding has increased of late years, owing to the increase in the workmen's wages, and leather is almost double the price it was fifty years ago; but the difference in the relative cost of morocco and calf has somewhat lessened. Even now, I think we must allow that the price of ordinary leather bindings is very low, considering the amount of work which must be put into each book. What is called "extra," as distinguished from "common" work, is dealt with under the two great divisions of "Forwarding" and "Finishing." The mode of binding a book has so often been described that it is not necessary to give any details here; but I will set down the various processes, in their successive order, to show how much there is to be done to a book between the time it enters and the time it leaves the binder's shop, and also that I may be able the better to refer to some of the points that seem to need fuller notice. The various opera-

* Fig. 2 is a specimen of work done for De Thou, who ranks after Grolier as a patron of bookbinding. In the reign of Edward VI., Grolier patterns were introduced into England. Some specimens of an elaborate and very artistic character have come down to us, while in some few instances the design is badly executed. A plain but elegant representation of one of Edward VI.'s books is given in Fig. 6.

tions which go to make up the "forwarding" of a book are—folding, collation, beating by hand or rolling in a machine, to make the book solid; re-collation, placing of plates, guarding of maps, &c.; pressing in sections, marking up for flexible backs, and sawing in for open backs; sewing, adding of end papers, glueing back, rounding back, backing, putting on the boards, pressing, cutting, colouring, marbling or gilding the edges, headbanding, lining up, covering, pasting down. In the "finishing" is included preparing the leather, the tooling on the back, sides, and inside, and the lettering.

Folding.—The first item in the above list is the folding of the sheets, and this opens up the whole question of the sizes of books; but I must not be seduced into dwelling upon this difficult point here, as it is too large a matter to be brought in parenthetically. While bibliographers are in confusion from the varieties of machine-made papers now in use, which make the old names meaningless, the binders continue to use a system of the finest gradations of size, regulated by the length and breadth in inches of the paper. Octavos, quartos, and folios are divided into foolscap, crown, copy, demy, medium, and royal; duodecimos (12mo.) only into demy, medium, and royal; and octodecimos (18mo.) into crown, demy, medium, and royal.

Backing.—Hollow backs are a comparatively modern invention, and came into use about the middle of the last century. In order to prevent the bands from interfering with the back, a saw is used to make an opening for the cord to rest in, and not project above the paper; this is called sawing in. The back of a bound book, however, usually looks so unfinished without bands, that false ones, consisting of stripes of stout leather or cardboard, are usually glued on to the back. In many of the old French ornamental bindings, the backs were without visible bands. These were not, however, sawn in, but the bands were hammered flat, and then covered. It is usual, after the sheets have been sewn and the back has been glued, to round the back, by a dexterous use of the hammer; but this is not always done, and a very marked instance of the opposite practice is to be found among the books of the late Rev. Theodore Williams, who insisted on having all the backs flat. These books are splendidly forwarded, and will fold right back with the greatest ease; but they are apt to get out of shape, and they are certainly not to the general taste.

End-papers.—The choice of suitable end-papers requires considerable taste in the binder, and many books have been spoilt by the incongruity displayed in their selection. Many very beautiful papers are now made, and there is an ample assortment of marbled and ordinary coloured papers to choose from. A paper stained in various shades and colours, and known as "Cobb paper," is generally used for half-calf bindings. I find, in a little book called "The Bookbinders' Manual" (1829), a curious account of the origin of this name, which is well worthy of quotation here, more particularly as I do not think that it is generally known. "Some years ago the sides of boarded books were usually covered with blue or marble paper. Mr. Cobb, paper-maker, obtained a patent for the manufacture of paper coloured in the pulp, which he proposed should be used for writing upon. The public, however, did not fall into his plan, and a large quantity of this paper came into the market cheap, some of which was purchased by a bookbinder, who used it to cover the sides of some common books, as a substitute for marble paper; this was much admired, and the use of coloured paper for the same purpose soon became generally adopted, and occasioned a great demand for Mr. Cobb's patent paper, which was thus, as it were, by accident, brought into general consumption."

Boards.—The stages of change in the boards of a book, from the thick wooden cover to the thin millboard, are worth recapitulation:—1. Books were bound with thick wooden boards, without any covering; 2, the back was then covered, to hide the leather thongs; 3, the whole of the sides was next covered; 4, the boards were made thin and shapeable; 5, pasteboard (made of layers of paper) replaced the wooden boards; and solid millboard (made from pulp) as now used, replaced pasteboard.

Edges.—The cutting of the edges of a book is a delicate operation, and some binders have gained an unenviable notoriety for "cropping." John Locke, writing to his friend Anthony Collins on the binding of a Greek Testament, says that nothing offends him "but the running of his [the binder's] paring-knife too deep into the margin; a knavish and intolerable fault in all our English bookbinders." This, however, is a sin which good binders religiously avoid. Here the need of careful folding is seen; for we sometimes come upon a book in which this essential has been neglected, with the result that the plough has taken off some of the letterpress with the margin,—a misfortune which is technically styled "bleeding."

In old books more attention was paid to the edges than is common now, and on the fore-edge the title was usually written or stamped. The back was often left comparatively plain, while ornament was lavished upon the leaves, which were embossed or *gauffré*. M. Libri mentions in the preface to his catalogue a fine specimen of binding in his possession, that formerly belonged to Francis I., which has the words "Fr. de Valois" impressed upon the embossed leaves. Sometimes fine drawings were painted upon the leaves, to be seen only when opened in a particular way. This art of painting landscapes and other designs upon the leaves of books was revived at the end of the last century, and many books at the beginning of the present century were so decorated. The ordinary mode of treating the edges of books is either by sprinkling, colouring, marbling, or gilding. Marbled or red edges under the gold always have a rich effect.

Head-bands, which finish off the top and bottom of the back, should be worked by hand, and form an integral part of the book by being fastened to several of the sections; but it has now become general to use a machine-made head-band, which is merely an ornament. This "improvement" is usually supposed to be a modern invention, but it will be found occasionally used in books nearly two centuries old.

Leathers.—A large number of different leathers have been used at various times for the covering of books, but the finest of all,—morocco,—did not come into general use before Grolier's time. The old leather used appears to have been a kind of calf, but of a much stronger and more durable character than that now in use. Vellum, which is a special preparation of the skins of animals, was used at an early period, and its fame for durability has always stood very high. At first, it was used without any ornamentation; but, after a time, stamped vellum came into fashion. Much of the old Italian was ornamented with gold tooling, and we have evidence that gilt vellum was popular in the seventeenth century from a passage in Webster's play, "The Devil's Law Case" (1623), where we read:—

> "There is, in my closet,
> A prayer-book that is covered with *gilt vellum*;
> Fetch it."

On the whole, however, we may safely say that the majority of old vellum-bound books are unornamented, and a large number of these are bound without boards. Hog-skin and pig-skin were formerly much used, and they have of late years gained an unenviable notoriety from their supposed liability to the ravages of the book-worm. Although the skins of seals and sharks, of kangaroo, and various other animals, have been used for the covering of books, morocco, russia, calf, sheep, and roan, which is a preparation of sheep, continue to form the binder's main stock-in-trade. John Whittaker bound a copy of "Turbeville on Hunting" in deer-skin, on the cover of which was placed a stag in silver, and Jeffery, the bookseller, bound Charles James Fox's historical work in fox's skin. It is even said that books have been clothed in human skin, both in France and England; but this is too unpleasant a subject for us to make too particular inquiries respecting it.

The manner of preparation of some of the finest goat-skin has been pretty successfully kept a secret, for although morocco is manufactured both in France and England, the best quality still comes from Morocco. The specially-dyed leather which is known as Spanish morocco can only be obtained in Spain, and no imitation of it has been successful. The Spaniards themselves imitate the colouring and grain in sheep. Russia leather, made from calf, cow, and ox hides, can only be obtained from the country which gives it a name. Its delicious odour is obtained by a particular treatment with the empyreumatic oil of the birch. Calf is much stronger in its natural state than after it has undergone dyeing; but law calf, which is blacked with acids in order to give it its underdone pie-crust colour, is still less durable than yed calf.

The general adoption of half-binding is an instance of modern meanness, and, in large libraries, we can generally fix a date when long sets ceased to be bound in whole leather, and were continued in half-binding. This style is useful for books that are not worth the expense of whole binding, but should be discouraged in the case of all works of intrinsic value; at all events, for private libraries. At one time it was thought an improvement to cover the sides with cloth; but it has since been found that paper is better, because cloth is liable to get spoilt by the spilling of a liquid that would do but little injury to the paper.

In passing from the details of forwarding to those of finishing, we have to deal with those questions of tooling, colouring, and inlaid work, to which I have already referred in my remarks on bookbinding as a fine art. I may, however, refer here to an ingenious contrivance of moveable stamps, proposed by Alexander Bain, which is described as follows:—"Four triangular blocks are employed, capable of being fixed in a simple adjustable frame, so as to suit any sized block. One adjustment with two actions of the press gives the four corners on both sides, and another adjustment with two actions of the press gives the middle ornament on both sides." For this invention the Society of Arts gave Mr. Bain, in 1838, the Silver Isis Medal and five pounds. I will now, in concluding the section relating to binding as a mechanical art, only make a few remarks on lettering.

Lettering was not common on English books until the latter end of the seventeenth century, but some French books were lettered at a much earlier period. A few,—although very few,—of Grolier's backs were lettered, and the Eves gained some fine effects on the backs of their books by the judicious use of the lettering as a part of the ornament. This is a difficult matter to speak upon with decision, because many old books have had letterings added, and many others have been rebacked. Lettering is a difficulty to the binder, and he should always be instructed as to what he ought to put upon the back. Dibdin mentions a bookbinder to the Cambridge University library, who lettered one of Erasmus's editions of the New Testament, printed by Froben, which has an address from the printer to the reader, thus,—"Frobenius Lectori."

Good lettering is a sign of good work, and bad binders can seldom make their letters straight. Gold lettering is, of course, the one most in use; but black letters on yellow morocco and on vellum are very effective. Porson had a rage for caligraphy, and once offered to letter the backs of some of Richard Heber's vellum-bound classics. Heber told him he would not let him do that, but would be thankful if he would transcribe, into a copy of "Athenæus," his valuable emendations, which he did. Lettering should be short, but it is not always easy to reduce the point out of long title-pages.

A bookseller, named John Tupling, published a small pamphlet in 1854, entitled "Folious Appearances: a Consideration on our Ways of Lettering Books." He objected to good books being lettered outside with their real titles, and proposed what he considered an improved system. He would letter Spenser's Poetical Works "Shadowy Granite," or "Most Admired Disorder," or "A Sunshine in a Shady Place"; Cary's "Dante" he would call "Alien Corn," or, if bound as it should be, in three parts, he would letter the "Inferno" "All the Damned"; the "Purgatory," "More Mild"; and the "Paradise," "Soft Ethereal Warmth." Shakspeare's label he would leave blank, unless "The Deep Pulsations of the World," or "Hamlet" would do; for he asks, "What is Shakspeare but Hamlet?" Addison and Johnson were not favourite authors of Mr. Tupling, and he would pillory the *Rambler* as "Remainder Biscuit," and the *Spectator* as "Most Poor Matters." This is amusing, but not very practical.

BOOKBINDING AS A MANUFACTURE.

We now come to the last division of the subject, in which bookbinding is considered as a manufacture. Books have always been issued by the publishers in some sort of cheap binding, prepared in a wholesale manner. The material used has varied at different times, but up to the middle of the last century this was usually some common leather. Paper boards had a long period of popularity, until they were displaced by cloth. I have seen the old-fashioned boards described as ugly, but I do not think that is a fair expression, as a well-preserved book in this binding is very pleasant to the eye of the bib-

liophile, and its chief fault is want of durability. When prepared calico was first found to be useful for the binding of books, a mighty revolution was inaugurated, and it is upon this branch of the trade that the improvements in machinery have chiefly been brought to bear. About the year 1825 cloth binding was first introduced by Archibald Leighton, but it was several years before its value became generally known. In the "Bookbinders' Manual," 1829, to which I have already referred, there is a casual reference to the new style. "Some boarded books, instead of a different coloured slip of paper, have their backs strengthened by a piece of fine canvas, which must be put on precisely as the paper above mentioned. There is another method of boarding greatly superior; the backs, instead of being sewn on bands, are sewn on strips of parchment, and the whole book is covered with canvas."

In the work entitled "Archibald Constable and his Literary Correspondence" (vol. iii., p. 310), a claim is made for "Constable's Miscellany," commenced in 1827, as the first series to be bound in cloth.* About the same time, some of the publications of the Society for the Diffusion of Useful Knowledge were issued in the same style, notably the "Library of Entertaining Knowledge." These bindings were of the simplest character, consisting of a plain covering of glazed calico, with a paper label. The labels were soon replaced by gold letterings, and the first book so treated is said to have been the edition of Byron's works in seventeen volumes duodecimo. The "Family Library," published by Murray, was bound in a still simpler style. The cloth used was of a light brown, and the title was printed on the cloth with printers' ink.

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As already remarked, cloth binding is entirely an English invention, and it is only of late years that foreigners have, to some extent, adopted it in place of their temporary paper covers. A slight but elegant covering for books has been found in vegetable parchment. This, which is much used in France, has been introduced into England by Messrs. Kegan Paul & Co.

One special characteristic of wholesale cloth binding is what goes by the name of "case-work," that is, the cover or case is made independent of the book, which is afterwards fastened into it. By this means, the covers can be produced in large numbers at a great saving in expense; and there is this further advantage, that much time is saved, when it is an object to issue a book almost immediately after the printing is finished. If due notice is given to a cloth binder with a large establishment, and the cases are prepared, an edition of 1,000 copies of a book can be, and often is, bound within twenty-four hours. It is not necessary here to describe the various processes of wholesale bookbinding, or to enumerate the various machines used for the purpose, but I may be allowed to refer to a report on the specimens of bookbinding shown in the Exhibition of 1874, which was drawn up by Mr. H. Trueman Wood, secretary of the Society, and printed in our *Journal* for May 29th, 1874.

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THE FRACTURE OF CAST IRON:* VISCOSITY AND REGELATION IN METALS.

VISCOSITY as observed in solids varies greatly in its range, both in different bodies at the same temperature, and in the same body at different temperatures. In some bodies its range is very wide, while in others it is very narrow; but in the majority of solids it is so extremely minute as to elude observation. In this respect, again, it resembles elasticity; for elasticity has in some solids, such as india-rubber, a very wide range; whilst in others, such as glass, it has a narrow range. When a solid is stretched beyond its limits of elasticity it suffers a permanent set. In like manner when a solid is stretched beyond its limit of viscosity it suffers breakage. The range of viscosity in a given solid body depends upon the temperature of the body and the speed with which a distorting force is applied. Take a stick of sealing-wax and bend it slowly with the fingers. With care it may be bent through a large angle. Now bend it quickly. It breaks. Lower the temperature: you find you have lessened its range of viscosity and increased its elasticity; and you have greater difficulty in bending it. Now raise the temperature higher than at first: you have at the same time increased the range of viscosity, and nearly destroyed the elasticity; and the sealing-wax may be bent in all directions with the greatest ease. Similar experiments might be made on glass with similar results. Glass when made hot enough to become soft is a highly viscous body, but when cooled down to the ordinary temperature of the atmosphere its viscosity disappears to general observation. It is nevertheless viscous to some extent, even at a low temperature, as is shown by the fact that glass will suffer a permanent set under an insistent pressure. This may be illustrated by describing an observation which I made upon glass tubing some years ago. Having several pieces of glass tube, some about the size of barometer tube, some smaller, and about 2 ft. long, I put them away in a box for future use. The box had a narrow strip of wood across the bottom which prevented the tubes from lying evenly, so that they rested about midway upon the strip, with one end touching the bottom of the box, leaving the other end free. On taking the tubes out of the box many months afterwards, I found they were all bent. They had suffered a permanent set, and that, too, under a very small pressure; but the pressure had remained on them a long time.

Now viscosity may be found in the metals. It may be found in lead, in copper, in silver, in gold, in wrought-iron, in cast-iron. You may remember that a few years ago the society visited Mr. Kirkaldy's Testing Works, and that during our visit Mr. Kirkaldy broke two pieces of wrought iron for our edification. Those two pieces of iron were totally unlike each other in their manner of breaking, and in the appearance of their fractured surfaces. One piece was very much elongated and diminished in the area of its cross section before it separated; the other was very little altered in this respect. The first showed a highly fibrous fracture; the second a cleavage fracture. The first broke silently; the second broke with a loud snap. The first was so hot immediately after breaking as to be unpleasant to the touch; the second was not perceptibly altered in temperature. The behaviour of the first piece showed that it had a considerable range of viscosity; in the second the range was reduced to a minimum. The overcoming of the viscosity in the first piece generated the heat, which raised the temperature of the iron. Those two pieces showed that the viscosity of wrought iron varies considerably in different samples, even at the same temperature. But it varies far more at different temperatures; for if wrought-iron be made red-hot or white-hot it is made highly viscous, and may, as is very well known, be hammered out or rolled out to any extent. This hammering or rolling, doing work upon the iron by overcoming its viscous resistance, generates heat in the metal, and keeps up its temperature. The effect of this may be observed at a rolling-mill, where a bar of iron may be seen to be visibly hotter immediately after passing through the rolls; but this accession of heat does not last long, for radiation is very rapid at this high temperature, and soon dissipates the heat. We see, then, that wrought iron is a highly viscous metal, and viscosity is one of the properties which help to give wrought iron its great value.

By the addition of a little carbon to wrought iron the metal is converted into steel, and its viscosity is very much diminished. By increasing the quantity of carbon, the metal becomes less and less viscous, until it is at length converted into cast-iron, and then its viscosity almost disappears. But it is not entirely gone; for, if a bar of cast-iron be made red-hot, it may, with care, be slightly bent. True, it cannot be bent very much; but the bending, however little, is sufficient to show that the metal is to some extent viscous. Small as this little viscosity is in hot cast-iron, it is still less in the cold metal. It can, nevertheless, be found, for experiments on the strength of cast-iron have shown that, when strained, it suffers a permanent set, and this is only another way of saying that the metal is viscous; for without viscosity, there could be no permanent set.

So much, then, for viscosity; we pass now to regelation.

Regelation is a property which is very generally regarded as being peculiar to ice. It does not appear to have been observed in any other kinds of matter; or, if observed, nobody says anything about it. The regelation of ice has attracted a very large amount of attention on account of the part which it plays, and the great scale of its operations, in the motion of glaciers. A glacier moves like a river: it moves faster in the middle than at the sides; it bends round corners and other obstacles; it contracts its dimensions at narrow places, and widens out to fill its bed at wide places, in the same way as a river does, only it does not move so fast as a river. In fact, a glacier is now generally regarded as a solid river. Now to explain this remarkable behaviour of a glacier two theories have been propounded: the first accounts for the motion by supposing that ice, although a solid, has a certain amount of viscosity which enables it to move like a fluid; the second, which is the more popular, denies the viscosity and brings in regelation to explain the motion. Regelation will explain a great many of the phenomena of glaciers, but will not explain all; and I think it will some day be found necessary to unite the two theories; for regelation is a great putting-together property, and viscosity, in virtue of the resistance which it offers to change of shape, is a great holding-together property, and the phenomena seem to need the assistance of both. Let us observe a few of the results of regelation, and then consider what are the conditions necessary to its operation.

A boy takes a handful of newly-fallen snow, and presses it into a snowball; but he finds that after the snow has lain on the ground all the night and has been frozen, his snowballing propensity has received a check; for he can no longer make the particles of snow cohere. A physicist will take some snow or pounded ice, and with his Bramah press will squeeze it into a solid block of transparent ice; or he will take

* Paper read by Mr. James Love, F.R.A.S., before the Civil and Mechanical Engineers' Society. (See p. 455, *ante*.)

two blocks of ice, and pressing them together with his hands, make them unite to form a single block. One of the prettiest experiments which has come under my notice is to lay a bar of ice horizontally upon two bearings at its ends, then place a thin wire upon the middle of the bar, and hang a weight to it. The wire will in time cut its way through the bar, and come out at the under side without leaving a trace of its path. These are some of the phenomena of regelation; how are they to be explained? or what are the conditions necessary to be present in order that regelation may ensue?

Some years ago Professor James Thomson showed, as a result of some researches into the laws of heat, that if certain (now well-established) laws of thermodynamics were true, then water under pressure would have its freezing-point lowered in the scale of temperature. Sir William Thomson put this to the test of experiment, and found that the freezing-point of water was lowered one-seventieth of a degree on Fahrenheit's scale for every additional atmosphere of pressure; proving that his brother's deduction was right. Some physicists, using this discovery to explain regelation, say that if a quantity of snow or pounded ice be pressed together, its freezing-point will be lowered, and some of the ice melted; then when the pressure is removed, the freezing-point will return to its normal position, and the water be frozen. The wire passing through the bar of ice is explained on this theory by supposing that the pressure of the wire upon the ice lowers the freezing-point of the small portion upon which it presses; the resulting drop of water then passes round from the under side to the upper side of the wire, where, being free from pressure, it freezes again; and as this is continuous, the wire leaves no trace of its passage through the bar. Other physicists say that since it requires such an enormous pressure to lower the freezing-point of water in any perceptible quantity, the pressures usually applied are not sufficient to account for regelation. They seem to disregard the fact that a great many of the forces which are combined to work under the laws of nature are individually so small as not only to elude ordinary observation, but to baffle the best observers, even when using the most refined methods which science can devise. It is a mistake not to bear this in mind; and it should not be forgotten that many of the great operations of nature are performed by the addition of a number of very small forces, and that some of the grandest results are brought about by the indefinite accumulation of infinitesimal quantities.

Now it appears to me that regelation is a quantity with two factors, either of which may vary inversely as the other. One factor has already been described; the other, which does not appear in the books, perhaps because authors think it so obvious as not to need any special mention, is the following: According to the laws of thermodynamics, motion is convertible into heat, in equatable quantities. If a dynamical pressure be applied to a resisting body so as to overcome the resistance and change the shape or volume of the body, or both the shape and the volume, heat is generated in the body. In the experiments which physicists perform upon snow and pounded ice with the Bramah press a considerable amount of pressure is applied; and since the shape of the ice is very much altered, as well as its particles being squeezed closer together, heat is generated in the ice. The motion of the ram is arrested by the ice, and transformed into heat. This heat must either raise the temperature of the ice or melt some of it, according to the temperature at the beginning of the experiment, whether it be below or at the melting point. In the formation of snowballs, and the pressing of two pieces of ice together with the hands, the snow and ice are very near the melting-point; but when the boy fails in his attempts at making snowballs, he fails because the snow is too cold, and he cannot apply enough pressure to raise its temperature to the melting-point. Put the snow into a mould, and apply sufficient pressure to raise its temperature to the proper height, then it will bind together. You see, then, that in order to effect regelation, the temperature must be brought near the melting-point; and this may be done in two ways at one operation, namely, by applying sufficient pressure to lower the melting-point and to raise the temperature, when, if the operation be carried far enough, some of the ice will be melted; then remove the pressure, and the water will be frozen again, because its freezing-point is raised, and any surplus heat is radiated away from it. The amount of pressure needed, according to this view, depends upon the temperature of the ice at the beginning of the operation. It appears, therefore, that the temperature at which regelation may take place can vary within very narrow limits. The temperature within these limits may be called the "temperature of regelation," or the "regelative temperature," whichever is the most convenient, as it will be wanted further on.

But why make regelation the peculiar property of ice, to the exclusion of all other kinds of matter? Why not examine other kinds of matter to see if they exhibit any similar property when placed under like conditions? For a long time after it was understood that ice floats upon water because it expands at the instant of solidification, it was taken for granted that water stood alone in this respect, and that nothing like it was to be found in the whole region of matter. It is now known that other kinds of matter behave like water when passing from the liquid to the solid form; and among them may be mentioned some of the metals, as for instance, brass, cast iron, lead, and some of its alloys. Now it appears that this phenomenon of a solid floating upon its own liquid, with which we are all familiar in the sea of ice floating upon water, this increase of volume at the instant of solidification is intimately connected with regelation; and if the two phenomena are connected we ought to find regelation in some of the metals. Let us see what can be found. We need not make any delicate experiments in the laboratory, for we may observe the phenomena as exhibited on a larger scale in the operations of the workshop. We may begin with lead, and note how it is treated in the manufacture of lead piping.

The lead pipes which are used in our houses for conveying water, and for other purposes, are made in the following manner:—A strong iron cylinder is fixed with its axis in a vertical position. A ram works in it underneath, and there is a hole in the upper end of the cylinder for receiving a die. The die is made of such a size as to give the required diameter to the lead pipe. The ram is lowered, and the cylinder is filled with melted lead. The lead radiates its heat through the cylinder, but in order that it may not cool down below a certain temperature, a fire is kept burning around and in contact with the cylinder. When the lead is cooled down to a little below its point of solidification, and is "set," as it is technically called, pressure is applied to the ram, and the lead is forced through the die. If the pressure be applied before the lead is sufficiently cooled, or before it is "set," a jet of liquid metal is thrown up, and a splash of lead is left on the ceiling above the cylinder, as evidence that that part of the operation was begun too soon. If the die were simply a round hole, a solid rod of lead instead of a pipe would be pushed through it, so the die is made of annular form by the insertion of a steel core in the centre of the hole. But this core has to be held in position. This is done by a bar across both the core and the die inside the cylinder, so that the core cannot be forced out through the die. The lead in its passage from the cylinder has to move round this bar; for the bar acts somewhat like an island in the middle of a river; or like an island in the middle of a glacier; it cuts the stream into two halves. How are these two streams of lead to join each other so as to make a pipe? We have seen that if the lead be liquid, a jet is thrown up, and instead of forming a pipe, falls as an unpleasant shower upon the workmen. If the lead were solid, its ductility would enable it to be forced through the die in the form of two half-cylinders; but ductility would not join the two halves together. How, then, is the joining effected? I see no way of doing it except by regelation; and that regelation does really take place appears clear when we examine the conditions of the operation. The conditions are: the lead must be "set," that is, it must be solid: and it must be kept as hot as it can be without melting. What is this but keeping it near the regelative temperature? Further, pressure must be applied to force it through the die. It appears, then, that the lead is forced against the die with a pressure which slightly lowers its melting-point; and, as the pressure overcomes a viscous resistance, heat is generated in the lead, thus slightly raising its already high temperature: these two causes acting together melt a portion of the lead. Then, before the lead gets quite through the die, the resistance diminishes; therefore the pressure diminishes; and as the pressure diminishes the melting-point returns to its normal height; meanwhile, that portion of the lead which is escaping the pressure is coming nearer to the external air; its temperature is therefore being lowered, because its heat is radiated more rapidly; these two causes acting together solidify the lead,—that is, regele the lead, and complete the formation of the pipe. In this way a lead pipe is formed by regelation. Regelation, then, is a property which the lead-pipe maker turns to his advantage; and in order that he may do so he recognises the importance of working with his metal at a proper temperature.

Now, is this property to be found in any other metal? I think it is; but its phenomena are too common to attract attention; for how is the welding of wrought-iron accomplished if not by regelation? Welding is so well known that a description of it here would be needless; and you can easily see for your yourselves how much it resembles regelation.

Having traced out regelation as exhibited in lead, and noticed its existence in wrought-iron, can we find it in cast-iron? It is well known that cast-iron cannot be welded, nor worked in any way at the forge; but I had noticed, among the many phenomena displayed in the foundry, two or three points which led me to think that a trace of regelation might, if properly sought, be found in cast-iron. With this in view I made some experiments upon cast-iron at a high temperature. In these experiments I was very ably joined by the foreman of the moulders, who, after receiving my explanation of what I wanted to find, took a warm interest in it, and gave me some very useful assistance; but notwithstanding all our care in bringing about the requisite conditions, and in excluding, as far as possible, the disturbing influences, our attempts failed to disclose anything that could be called regelation. Reflecting upon these experiments, I began to consider what are the conditions necessary to the successful welding of wrought-iron. The conditions are, a proper temperature, a clean fire, and pressure. Now the clean fire gave a clue to the discovery of the secret. It is known to every smith that certain matters getting into his fire will spoil it for welding; among these are sulphur, lead, brass, and, to a less extent, cast-iron. What is there in cast-iron that can spoil the fire for welding? It cannot be the carbon, because carbon is one of the most important elements used in making a fire. What, then, is it? Let us trace out the phenomena. With a clean fire a smith finds no difficulty in welding good wrought-iron; but he finds a little difficulty in welding spring steel, that is, iron containing a little carbon; with a little higher quality of steel he finds a little greater difficulty; and as the steel gets more steely, that is, as the iron contains a larger and larger percentage of carbon, so the difficulty of welding increases; until, when the iron contains as much carbon as it can take up, and thereby becomes cast-iron, it cannot be welded at all. The evidence points strongly towards the carbon as being the disturbing agent; and yet the carbon which is burnt in the fire exercises no disturbing influence. But the carbon in cast-iron is not in the same form as the carbon in the fire; in the fire it takes the ordinary combustible form; in cast-iron it takes the form known as graphite: this difference of form might make all the difference in its influence upon welding. Smiths sometimes dip the iron which they are heating into sand, to prevent the projecting corners from burning away before the iron is hot enough throughout the surfaces which they intend to weld together; and the sand does not prevent the welding. Remembering this, I thought if two pieces of wrought-iron were similarly dipped into some powdered graphite, it would serve as a test of the influence of graphite upon welding, and therefore upon the regelation of iron. Acting upon this thought I induced a smith to make an experiment, under my observation, in the following manner. He took two pieces of wrought-iron and welded them together, in order to show that his fire was clean, or to show that there was nothing in his fire which could spoil the welding; he then cut the bar into two pieces a few inches beyond the weld, and heated them again; this time he dipped the two hot ends into the powdered graphite, and then tried to weld them together, but failed; for the two pieces of iron would not unite. You see we had throughout the experiment the same fire, the same iron, the same everything, except the graphite; when the

liophile, and its chief fault is want of durability. When prepared calico was first found to be useful for the binding of books, a mighty revolution was inaugurated, and it is upon this branch of the trade that the improvements in machinery have chiefly been brought to bear. About the year 1825 cloth binding was first introduced by Archibald Leighton, but it was several years before its value became generally known. In the "Bookbinders' Manual," 1829, to which I have already referred, there is a casual reference to the new style. "Some boarded books, instead of a different coloured slip of paper, have their backs strengthened by a piece of fine canvas, which must be put on precisely as the paper above mentioned. There is another method of boarding greatly superior; the backs, instead of being sewn on bands, are sewn on strips of parchment, and the whole book is covered with canvas."

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THE FRACTURE OF CAST IRON:* VISCOSITY AND REGELATION IN METALS.

VISCOSITY as observed in solids varies greatly in its range, both in different bodies at the same temperature, and in the same body at different temperatures. In some bodies its range is very wide, while in others it is very narrow; but in the majority of solids it is so extremely minute as to elude observation. In this respect, again, it resembles elasticity; for elasticity has in some solids, such as india-rubber, a very wide range; whilst in others, such as glass, it has a narrow range. When a solid is stretched beyond its limits of elasticity it suffers a permanent set. In like manner when a solid is stretched beyond its limit of viscosity it suffers breakage. The range of viscosity in a given solid body depends upon the temperature of the body and the speed with which a distorting force is applied. Take a stick of sealing-wax and bend it slowly with the fingers. With care it may be bent through a large angle. Now bend it quickly. It breaks. Lower the temperature: you find you have lessened its range of viscosity and increased its elasticity; and you have greater difficulty in bending it. Now raise the temperature higher than at first: you have at the same time increased the range of viscosity, and nearly destroyed the elasticity; and the sealing-wax may be bent in all directions with the greatest ease. Similar experiments might be made on glass with similar results. Glass when made hot enough to become soft is a highly viscous body, but when cooled down to the ordinary temperature of the atmosphere its viscosity disappears to general observation. It is nevertheless viscous to some extent, even at a low temperature, as is shown by the fact that glass will suffer a permanent set under an insistent pressure. This may be illustrated by describing an observation which I made upon glass tubing some years ago. Having several pieces of glass tube, some about the size of barometer tube, some smaller, and about 2 ft. long, I put them away in a box for future use. The box had a narrow strip of wood across the bottom which prevented the tubes from lying evenly, so that they rested about midway upon the strip, with one end touching the bottom of the box, leaving the other end free. On taking the tubes out of the box many months afterwards, I found they were all bent. They had suffered a permanent set, and that, too, under a very small pressure; but the pressure had remained on them a long time.

Now viscosity may be found in the metals. It may be found in lead, in copper, in silver, in gold, in wrought-iron, in cast-iron. You may remember that a few years ago the society visited Mr. Kirkaldy's Testing Works, and that during our visit Mr. Kirkaldy broke two pieces of wrought iron for our edification. Those two pieces of iron were totally unlike each other in their manner of breaking, and in the appearance of their fractured surfaces. One piece was very much elongated and diminished in the area of its cross section before it separated; the other was very little altered in this respect. The first showed a highly fibrous fracture; the second a cleavage fracture. The first broke silently; the second broke with a loud snap. The first was so hot immediately after breaking as to be unpleasant to the touch; the second was not perceptibly altered in temperature. The behaviour of the first piece showed that it had a considerable range of viscosity; in the second the range was reduced to a minimum. The overcoming of the viscosity in the first piece generated the heat, which raised the temperature of the iron. Those two pieces showed that the viscosity of wrought iron varies considerably in different samples, even at the same temperature. But it varies far more at different temperatures; for if wrought-iron be made red-hot or white-hot it is made highly viscous, and may, as is very well known, be hammered out or rolled out to any extent. This hammering or rolling, doing work upon the iron by overcoming its viscous resistance, generates heat in the metal, and keeps up its temperature. The effect of this may be observed at a rolling-mill, where a bar of iron may be seen to be visibly hotter immediately after passing through the rolls; but this accession of heat does not last long, for radiation is very rapid at this high temperature, and soon dissipates the heat. We see, then, that wrought iron is a highly viscous metal, and viscosity is one of the properties which help to give wrought iron its great value.

By the addition of a little carbon to wrought iron the metal is converted into steel, and its viscosity is very much diminished. By increasing the quantity of carbon, the metal becomes less and less viscous, until it is at length converted into cast-iron, and then its viscosity almost disappears. But it is not entirely gone; for, if a bar of cast-iron be made red-hot, it may, with care, be slightly bent. True, it cannot be bent very much; but the bending, however little, is sufficient to show that the metal is to some extent viscous. Small as this little viscosity is in hot cast-iron, it is still less in the cold metal. It can, nevertheless, be found, for experiments on the strength of cast-iron have shown that, when strained, it suffers a permanent set, and this is only another way of saying that the metal is viscous; for without viscosity, there could be no permanent set.

So much, then, for viscosity; we pass now to regelation.

Regelation is a property which is very generally regarded as being peculiar to ice. It does not appear to have been observed in any other kinds of matter; or, if observed, nobody says anything about it. The regelation of ice has attracted a very large amount of attention on account of the part which it plays, and the great scale of its operations, in the motion of glaciers. A glacier moves like a river: it moves faster in the middle than at the sides; it bends round corners and other obstacles; it contracts its dimensions at narrow places, and widens out to fill its bed at wide places, in the same way as a river does, only it does not move so fast as a river. In fact, a glacier is now generally regarded as a solid river. Now to explain this remarkable behaviour of a glacier two theories have been propounded: the first accounts for the motion by supposing that ice, although a solid, has a certain amount of viscosity which enables it to move like a fluid; the second, which is the more popular, denies the viscosity and brings in regelation to explain the motion. Regelation will explain a great many of the phenomena of glaciers, but will not explain all; and I think it will some day be found necessary to unite the two theories; for regelation is a great putting-together property, and viscosity, in virtue of the resistance which it offers to change of shape, is a great holding-together property, and the phenomena seem to need the assistance of both. Let us observe a few of the results of regelation, and then consider what are the conditions necessary to its operation.

A boy takes a handful of newly-fallen snow, and presses it into a snowball; but he finds that after the snow has lain on the ground all the night and has been frozen, his snowballing propensity has received a check; for he can no longer make the particles of snow cohere. A physicist will take some snow or pounded ice, and with his Bramah press will squeeze it into a solid block of transparent ice; or he will take

* Paper read by Mr. James Love, F.R.A.S., before the Civil and Mechanical Engineers' Society. (See p. 455, *ante*.)

two blocks of ice, and pressing them together with his hands, make them unite to form a single block. One of the prettiest experiments which has come under my notice is to lay a bar of ice horizontally upon two bearings at its ends, then place a thin wire upon the middle of the bar, and hang a weight to it. The wire will in time cut its way through the bar, and come out at the under side without leaving a trace of its path. These are some of the phenomena of regelation; how are they to be explained? or what are the conditions necessary to be present in order that regelation may ensue?

Some years ago Professor James Thomson showed, as a result of some researches into the laws of heat, that if certain (now well-established) laws of thermodynamics were true, then water under pressure would have its freezing-point lowered in the scale of temperature. Sir William Thomson put this to the test of experiment, and found that the freezing-point of water was lowered one-seventieth of a degree on Fahrenheit's scale for every additional atmosphere of pressure; proving that his brother's deduction was right. Some physicists, using this discovery to explain regelation, say that if a quantity of snow or pounded ice be pressed together, its freezing-point will be lowered, and some of the ice melted; then when the pressure is removed, the freezing-point will return to its normal position, and the water be frozen. The wire passing through the bar of ice is explained on this theory by supposing that the pressure of the wire upon the ice lowers the freezing-point of the small portion upon which it presses; the resulting drop of water then passes round from the under side to the upper side of the wire, where, being free from pressure, it freezes again; and as this is continuous, the wire leaves no trace of its passage through the bar. Other physicists say that since it requires such an enormous pressure to lower the freezing-point of water in any perceptible quantity, the pressures usually applied are not sufficient to account for regelation. They seem to disregard the fact that a great many of the forces which are combined to work under the laws of nature are individually so small as not only to elude ordinary observation, but to baffle the best observers, even when using the most refined methods which science can devise. It is a mistake not to bear this in mind; and it should not be forgotten that many of the great operations of nature are performed by the addition of a number of very small forces, and that some of the grandest results are brought about by the indefinite accumulation of infinitesimal quantities.

Now it appears to me that regelation is a quantity with two factors, either of which may vary inversely as the other. One factor has already been described; the other, which does not appear in the books, perhaps because authors think it so obvious as not to need any special mention, is the following: According to the laws of thermodynamics, motion is convertible into heat, in equatable quantities. If a dynamical pressure be applied to a resisting body so as to overcome the resistance and change the shape or volume of the body, or both the shape and the volume, heat is generated in the body. In the experiments which physicists perform upon snow and pounded ice with the Bramah press a considerable amount of pressure is applied; and since the shape of the ice is very much altered, as well as its particles being squeezed closer together, heat is generated in the ice. The motion of the ram is arrested by the ice, and transformed into heat. This heat must either raise the temperature of the ice or melt some of it, according to the temperature at the beginning of the experiment, whether it be below or at the melting point. In the formation of snowballs, and the pressing of two pieces of ice together with the hands, the snow and ice are very near the melting-point; but when the boy fails in his attempts at making snowballs, he fails because the snow is too cold, and he cannot apply enough pressure to raise its temperature to the melting-point. Put the snow into a mould, and apply sufficient pressure to raise its temperature to the proper height, then it will bind together. You see, then, that in order to effect regelation, the temperature must be brought near the melting-point; and this may be done in two ways at one operation, namely, by applying sufficient pressure to lower the melting-point and to raise the temperature, when, if the operation be carried far enough, some of the ice will be melted; then remove the pressure, and the water will be frozen again, because its freezing-point is raised, and any surplus heat is radiated away from it. The amount of pressure needed, according to this view, depends upon the temperature of the ice at the beginning of the operation. It appears, therefore, that the temperature at which regelation may take place can vary within very narrow limits. The temperature within these limits may be called the "temperature of regelation," or the "regelative temperature," whichever is the most convenient, as it will be wanted further on.

But why make regelation the peculiar property of ice, to the exclusion of all other kinds of matter? Why not examine other kinds of matter to see if they exhibit any similar property when placed under like conditions? For a long time after it was understood that ice floats upon water because it expands at the instant of solidification, it was taken for granted that water stood alone in this respect, and that nothing like it was to be found in the whole region of matter. It is now known that other kinds of matter behave like water when passing from the liquid to the solid form; and among them may be mentioned some of the metals, as for instance, brass, cast iron, lead, and some of its alloys. Now it appears that this phenomenon of a solid floating upon its own liquid, with which we are all familiar in the sea of ice floating upon water, this increase of volume at the instant of solidification is intimately connected with regelation; and if the two phenomena are connected we ought to find regelation in some of the metals. Let us see what can be found. We need not make any delicate experiments in the laboratory, for we may observe the phenomena as exhibited on a larger scale in the operations of the workshop. We may begin with lead, and note how it is treated in the manufacture of lead piping.

The lead pipes which are used in our houses for conveying water, and for other purposes, are made in the following manner:—A strong iron cylinder is fixed with its axis in a vertical position. A ram works in it underneath, and there is a hole in the upper end of the cylinder for receiving a die. The die is made of such a size as to give the required diameter to the lead pipe. The ram is lowered, and the cylinder is filled with melted lead. The lead radiates its heat through the cylinder, but in order that it may not cool down below a certain temperature, a fire is kept burning around and in contact with the cylinder. When the lead is cooled down to a little below its point of solidification, and is "set," as it is technically called, pressure is applied to the ram, and the lead is forced through the die. If the pressure be applied before the lead is sufficiently cooled, or before it is "set," a jet of liquid metal is thrown up, and a splash of lead is left on the ceiling above the cylinder, as evidence that that part of the operation was begun too soon. If the die were simply a round hole, a solid rod of lead instead of a pipe would be pushed through it, so the die is made of annular form by the insertion of a steel core in the centre of the hole. But this core has to be held in position. This is done by a bar across both the core and the die inside the cylinder, so that the core cannot be forced out through the die. The lead in its passage from the cylinder has to move round this bar; for the bar acts somewhat like an island in the middle of a river; or like an island in the middle of a glacier; it cuts the stream into two halves. How are these two streams of lead to join each other so as to make a pipe? We have seen that if the lead be liquid, a jet is thrown up, and instead of forming a pipe, falls as an unpleasant shower upon the workmen. If the lead were solid, its ductility would enable it to be forced through the die in the form of two half-cylinders; but ductility would not join the two halves together. How, then, is the joining effected? I see no way of doing it except by regelation; and that regelation does really take place appears clear when we examine the conditions of the operation. The conditions are: the lead must be "set," that is, it must be solid: and it must be kept as hot as it can be without melting. What is this but keeping it near the regelative temperature? Further, pressure must be applied to force it through the die. It appears, then, that the lead is forced against the die with a pressure which slightly lowers its melting-point; and, as the pressure overcomes a viscous resistance, heat is generated in the lead, thus slightly raising its already high temperature: these two causes acting together melt a portion of the lead. Then, before the lead gets quite through the die, the resistance diminishes; therefore the pressure diminishes; and as the pressure diminishes the melting-point returns to its normal height; meanwhile, that portion of the lead which is escaping the pressure is coming nearer to the external air; its temperature is therefore being lowered, because its heat is radiated more rapidly; these two causes acting together solidify the lead,—that is, regele the lead, and complete the formation of the pipe. In this way a lead pipe is formed by regelation. Regelation, then, is a property which the lead-pipe maker turns to his advantage; and in order that he may do so he recognises the importance of working with his metal at a proper temperature.

Now, is this property to be found in any other metal? I think it is; but its phenomena are too common to attract attention; for how is the welding of wrought-iron accomplished if not by regelation? Welding is so well known that a description of it here would be needless; and you can easily see for your yourselves how much it resembles regelation.

Having traced out regelation as exhibited in lead, and noticed its existence in wrought-iron, can we find it in cast-iron? It is well known that cast-iron cannot be welded, nor worked in any way at the forge; but I had noticed, among the many phenomena displayed in the foundry, two or three points which led me to think that a trace of regelation might, if properly sought, be found in cast-iron. With this in view I made some experiments upon cast-iron at a high temperature. In these experiments I was very ably joined by the foreman of the moulders, who, after receiving my explanation of what I wanted to find, took a warm interest in it, and gave me some very useful assistance; but notwithstanding all our care in bringing about the requisite conditions, and in excluding, as far as possible, the disturbing influences, our attempts failed to disclose anything that could be called regelation. Reflecting upon these experiments, I began to consider what are the conditions necessary to the successful welding of wrought-iron. The conditions are, a proper temperature, a clean fire, and pressure. Now the clean fire gave a clue to the discovery of the secret. It is known to every smith that certain matters getting into his fire will spoil it for welding; among these are sulphur, lead, brass, and, to a less extent, cast-iron. What is there in cast-iron that can spoil the fire for welding? It cannot be the carbon, because carbon is one of the most important elements used in making a fire. What, then, is it? Let us trace out the phenomena. With a clean fire a smith finds no difficulty in welding good wrought-iron; but he finds a little difficulty in welding spring steel, that is, iron containing a little carbon; with a little higher quality of steel he finds a little greater difficulty; and as the steel gets more steely, that is, as the iron contains a larger and larger percentage of carbon, so the difficulty of welding increases; until, when the iron contains as much carbon as it can take up, and thereby becomes cast-iron, it cannot be welded at all. The evidence points strongly towards the carbon as being the disturbing agent; and yet the carbon which is burnt in the fire exercises no disturbing influence. But the carbon in cast-iron is not in the same form as the carbon in the fire; in the fire it takes the ordinary combustible form; in cast-iron it takes the form known as graphite: this difference of form might make all the difference in its influence upon welding. Smiths sometimes dip the iron which they are heating into sand, to prevent the projecting corners from burning away before the iron is hot enough throughout the surfaces which they intend to weld together; and the sand does not prevent the welding. Remembering this, I thought if two pieces of wrought-iron were similarly dipped into some powdered graphite, it would serve as a test of the influence of graphite upon welding, and therefore upon the regelation of iron. Acting upon this thought I induced a smith to make an experiment, under my observation, in the following manner. He took two pieces of wrought-iron and welded them together, in order to show that his fire was clean, or to show that there was nothing in his fire which could spoil the welding; he then cut the bar into two pieces a few inches beyond the weld, and heated them again; this time he dipped the two hot ends into the powdered graphite, and then tried to weld them together, but failed; for the two pieces of iron would not unite. You see we had throughout the experiment the same fire, the same iron, the same everything, except the graphite; when the

graphite was *not* used the welding was successful; but when the graphite was used the welding failed. So it turns out, after all, that carbon is the disturbing element which prevents the regelation of cast-iron; and in order that it may exert its influence it must be in the form of graphite, that form in which it is found in cast-iron.

ABINGDON SEWERAGE.

INSTITUTION OF CIVIL ENGINEERS.

At the meeting on Tuesday, the 13th of April, the first paper read was on the "Abingdon Sewerage," by Mr. Charles Foote Gower, C.E.

Being under notice to desist from any longer discharging the sewage of their town into the River Thames, the authorities of Abingdon called upon Mr. Bailey Denton, M. Inst. C.E., in the year 1874, to advise them as to the best means of dealing with the sewage, so as to satisfy the requirements of the Thames Conservators. Mr. Denton having, with the assistance of the author, made an inspection of the town and neighbourhood, recommended that 20 acres of land should be acquired, for the purpose of cleansing the sewage by intermittent filtration, and gave at the same time a general description of the necessary sewers, pumping-station, and other works since carried out. The population of Abingdon was about 6,000; but provision had been made, in the construction of the works, for at least 10,000 persons. The normal flow of sewage, when undiluted, was taken at 250,000 gallons per day. The ordinary level of the Thames at Abingdon was 162 ft. above Ordnance datum. In flood time it reached nearly 167 ft. The River Ock was kept up for the purpose of working mills at a level of 168 ft. The surface levels in the streets of the town varied from about 170 ft. to 200 ft. above Ordnance datum. The subsoil water in that part of the town contiguous to the Thames accorded pretty nearly with the river level, 162 ft.; but in other parts of the town, previously to the carrying out of the sewerage works, it was regulated by the level of the Ock Mill stream, and the consequence was that it sometimes rose, in wet seasons, almost to the level of the streets, and proved injurious to the health of the inhabitants. The sewers in Abingdon were formerly very inadequate for the duty required of them; they had been retained, however, in connexion with the street-gullies, to carry off rain-water from the streets. The level of the land selected for the purification and utilisation of the sewage varied from 165 ft. to 168 ft. above Ordnance datum. From the general surface-height and contour of the town, it was impracticable to bring the sewage on to this land without lifting it from 10 ft. to 20 ft. from the invert of the outfall-sewer. In the design for the new sewers, no rain-water was to be admitted except from backyards, roofs, and other surfaces, from which it could not economically be kept out.

In laying the sewers the joints were caulked with tarred gasket and cement, and in some cases were bedded and surrounded with concrete, or clay puddle, to prevent the ingress of subsoil-water or the escape of the sewage into the surrounding soil. Meanwhile, the town having been without a public water-supply, arrangements were made for flushing the sewers by inlets from the river, and from other sources. The main outfall sewer from the town was 18 in. in diameter, and was capable of discharging 2,000,000 gallons in twenty-four hours, being eight times the estimated dry-weather flow of sewage. The secondary sewers in the town consisted of 15-in., 12-in., and 9-in. pipes. The lower portion of the outfall-sewer was 3 ft. 6 in. in diameter, and served as a reservoir to hold the night flow of sewage, in connexion with the pumping-station. This sewer was at times subject to considerable internal pressure from the sewage collected in it, as well as to external pressure from the subsoil water outside, being 8 ft. below the ordinary level of the Thames. Each engine could pump 400 gallons of sewage per minute; thus both engines, working together, would lift above 1,000,000 gallons per day. In connexion with the engines, a storm-overflow from the pumping reservoir had been provided, to relieve the latter in case of heavy storms, floods, or accidents to the engines; upwards of 100,000 gallons must flow into the reservoir before any overflow could take place. This provision was more than enough for the night-flow of sewage, if the reservoir was pumped empty at the close of the day. The cost of the sewerage of the town had been 8,750*l.*, including a portion of the charge for private connecting sewers, which were executed by the contractor for the main sewers up to the boundaries of private properties on each side of the street. The cost of the engines and pumping station, including fencing of yard, weighing-machine, and sewage-screens, had been 2,500*l.* of which sum the engines cost about 800*l.* The annual cost of pumping for the last two years had not exceeded 150*l.*; but with an increase of water-supply it would probably be somewhat greater. The area of land acquired by the Corporation of Abingdon was more than double what Mr. Denton at first proposed. The farm, with cottage and buildings, was let at an annual rental of 4*l.* 10*s.* per acre, the Corporation pumping the sewage. The works were practically completed in 1877, and from that time, with but little exception, the Thames had been free from Abingdon sewage; the land first received it, and after passing through the soil, the effluent water flowed into the river. Samples of the effluent were found by analysis to be better in quality than the water of many of the wells in use in the town. The sewers were freely ventilated throughout the town by shafts, which were also used for inspection and for flushing. The latter operation had to be put into force at least twice a week, owing to the comparatively sluggish flow, the amount of water used for domestic purposes being very small.

THE BEDFORD PARK ESTATE, TURNHAM-GREEN.

SALE OF HOUSES.

On Monday, a numerous company was attracted to the Auction Mart, the occasion being the sale of several recently-erected residences on the Bedford Park Estate at Turnham-green. The property consisted of seventeen detached and semi-detached houses, in the Queen Anne style of architecture, situated in the Bath-road. Several of the residences were stated to be let, and it was added that possession of the others could be had on completion. The estimated annual value of the property was said to be 1,070*l.*, the rentals varying from 50*l.* to 95*l.* per annum. The whole of the residences are held for a term, of which ninety-five years were unexpired at Michaelmas, 1879, at ground-rents varying from 9*l.* to 15*l.* per annum. The printed particulars stated that the estate had been arranged with a view to establish a residential neighbourhood of an artistic nature, and so completely had that original intention been carried out that there was not a single residence built upon the estate in any other than the Queen Anne style of architecture, the church, which was just completed,* the club, which had nearly 200 members, and the co-operative stores, now all but completed, being characteristic of the adopted style of architecture. The auctioneers were Messrs. Baxter, Payne, & Lepper, of King William-street, and Bromley, Kent. The auctioneer having adverted to the attractive nature of the several houses, erected from the designs of Mr. R. Norman Shaw, R.A., the architect to the estate, the sale, consisting of seventeen lots, proceeded, when the biddings at once became very spirited, and it was understood in the room that amongst the purchasers were the occupants of the houses. The first lot offered was described as a bijou villa in the Queen Anne style of architecture, the estimated rental of which was 50*l.*, and the ground-rent 9*l.* It was sold for 610*l.* Lots two, three, four, and five, described as similar to the first named, realised respectively 600*l.*, 610*l.*, 615*l.*, and 625*l.* Lot seven, a semi-detached house, let at 70*l.* per annum, realised 900*l.* Lots eight and nine, let at 60*l.* per annum, were sold for 775*l.* and 750*l.* respectively. Lot eleven, a spacious detached villa, let at 83*l.* 5*s.* per annum, realised 1,150*l.*; and lot twelve, a similar detached residence, of the estimated annual value of 95*l.*, was sold for 1,200*l.* Lots thirteen, fourteen, fifteen, and sixteen, semi-detached villas, estimated to produce 70*l.* per annum, realised each 770*l.*; and lot seventeen, a detached residence, situated in the midst of a garden, and estimated to produce 90*l.* per annum, was knocked down for 1,000*l.* The total proceeds of the day's sale, exclusive of the lots sold by private contract, amounted to 11,915*l.*, and at the prices given the rentals would return from seven to eight per cent. per annum, deducting the ground-rent.

* The Bishop of London consecrated this church on Saturday last. It is dedicated to St. Michael and All Angels, and has cost 6,000*l.*

PARIS PALACES AND THEIR MONEY VALUE.

The Direction des Bâtiments Civils et des Palais Nationaux has recently drawn up an estimate of the value of the palaces now used for public purposes in and about Paris. For instance, the Council of State now meets at the Palais Royal, which was formerly the dwelling-house of Prince Jerome Bonaparte, and this structure is considered as worth 400,000*l.* The Palace of the Luxembourg, where the Senate hold their sittings, is estimated at 2,400,000*l.*, while the residence of the President of the Republic, the Palace of the Elysée, is put down at only 400,000*l.* The Palace of Versailles, with its park and dependencies, is thought to equal a money value of 4,480,000*l.*, and that of the Trianon, 559,120*l.* The Château de St. Cloud, though so badly treated by Mont Valérien during the siege, is still put down for a sum of 199,080*l.*, and the Château de Rambouillet, 121,760*l.* The Château de Compiègne figures for the sum of 520,000*l.*, and Fontainebleau for 1,200,000*l.*

Unfortunately, the compilers of these estimates have not dared attempt to qualify by a money value the two palaces in which the public will probably take the most interest,—the Palace of the Louvre and the Palace of the Tuileries. It would, in any case, have been easy to give the cost of the two new wings of the Tuileries, the Pavillon Flore and the Pavillon Masson, which have just been rebuilt, and are used for public purposes. With persons devoid of taste, or plunged in ignorance, there is perhaps no more effective means of explaining the importance and value of an object or building than by affixing thereto the price it would cost to procure anything similar. The above figures cannot, however, take into account the art that has been displayed in the constructions mentioned. The estimate therefore is very imperfect, but it is nevertheless not devoid of interest.

WORKS AT ST. STEPHEN'S CHURCH, WALBROOK.

Wren's well-known Church of St. Stephen, Walbrook, in the City, at the back of the Mansion House, is at present undergoing repairs and restorations, both externally and internally, being closed for the purpose. As regards the outside of the building, the repairing and refacing of the tower is first to be carried out, and for this purpose scaffolding has been in course of erection around the structure during the last few days, and workmen are now engaged in clearing away the decayed portions of the stonework from the face of the tower. The interior restorations will consist of the cleaning and re-colouring and painting the walls, ceiling, and the large central dome, together with the cleaning of the various monuments and tablets, but we learn that no alterations are to be made in the existing seat arrangements.

CREOSOTING TIMBER FOR PIERS AND HARBOUR WORKS.

In the discussion which followed the reading of Mr. T. Cole's paper on the "Teredo and other Marine Pests," before the Civil and Mechanical Engineers' Society the other evening, it was stated by Mr. R. M. Bancroft that the method of creosoting timber had been used for upwards of twenty-six years by Mr. W. Teasdel, C.E., of the Harbour Works, Great Yarmouth, and he found it most effectual in resisting the attacks of these destructive pests.

Elm, beech, and fir will absorb the creosote freely, if well seasoned and dry,—beech perhaps the best. Creosote will penetrate into the heart of porous fir, if quickly grown and of large grain, particularly Dantzic. Timber and deals kept under pressure at 110 lb. to 120 lb. per square inch, from thirty-six to forty-eight hours in warm weather, have absorbed as much as 10 lb. to 14 lb. per cubic foot, and creosoted timbers in sea and river works have stood ten to eleven years, and not yet been touched by the worms, where oak timber has in the same work been completely destroyed.

Creosoted timber ought to be kept six months

before being used, as the creosote then becomes glutinous and holds the fibres of the timber more closely together.

You may exhaust the sap from oak and elm, but from timber that is full of turpentine or resin, you cannot exhaust anything, or force in any great quantity of creosote, the pores being full; there are veins of turpentine or resin in some fir, pitch-pine especially, and in these the creosote does not enter, but the worm will.

Fir creosoted is very much used, it being easy to come at, and cheap, not costing half the price of greenheart, and it can be had any length or size required; but greenheart of first quality will last longer than any other wood in water where there are teredo and other worms, though it is not suitable for all works, and is at times very expensive; some has been in works twenty-six years, and been scarcely touched by these destructive pests.

Oak timber, carefully nailed with 14 lb. scupper-nails, has been in Great Yarmouth harbour works thirty-two years, and is still sound.

Samples of creosote were exhibited during the discussion.

A QUARTERLY EXHIBITION OF FURNITURE.

AT the permanent exhibition, held at the depository of historical furniture on the Quai d'Orsay, Paris, the objects exhibited have to be changed every quarter, and the furniture and curiosities that have been before the public since January have just been removed, to make way for the treasures that the people will be free to contemplate during April, May, and June. In the first room is a set of four pieces of Gobelins tapestry, dating from the eighteenth century, and executed from designs by Boucher, representing Cupid and Psyche, and other mythological subjects; a set of six pieces of eighteenth-century work, from the designs of Andran, representing Saturn, Venus, Jupiter, Juno, Neptune, and Diana; and, finally, five pieces of Beauvais tapestry, from designs by Leprince, Boucher, and Cazanova. Among the historical furniture are a desk that belonged to Louis XVI., Marie Antoinette's sedan-chair, the arm-chair that Napoleon I. used as a throne, the great emperor's camp writing-table, his chess-board, the King of Rome's cradle, a Sèvres cabinet, dating from the marriage of the Duke of Orleans in 1837, &c.

The second room contains ten fine pieces of tapestry, from Coypel's designs, representing the "Triumph of Hercules," and also various specimens of art in furniture, such as gorgeous marquetry cabinets, monumental vases in porphyry and onyx, and fine specimens of goldsmith's work.

THE COST OF CHURCH BELLS.

STEEL BELLS.

SIR,—Thirty millions of money, we have recently been told by episcopal authority, have been spent in building, rebuilding, and restoring the churches of England during the last forty years. Another estimate, a year or two back, raised the number of new churches built to some 150 per year, a figure which fairly tallies with the other estimate. Every other day, then, Sundays excluded, the question must arise to perplex rector, or churchwarden, or founder, or Building Committee, "How about the bells?" You will do a great service, therefore, to a large number of persons who supply the sinews of war for a very important branch of the building trade, if you will give them some information on the subject, whether of your own experience, or by inviting contributions in your pages from those who are able to supply the definite information of which we are so greatly in need.

I am not asking now for information as to any musical question, or as to the weights and forms of bells. I write to inquire for financial information, and I am moved to do so by two circumstances which happened lately to come to my knowledge on the same day, and which may be taken to represent as it were the two poles of the question on which I seek for exact information.

One was a case in which parishioners who had just rebuilt an ancient church, in a style of which they had good reason to feel proud, came to the conclusion that the belfry ought not to be voiceless. There was an old peal of bells, of which one, if not two, was cracked, and the Building Committee came to the conclusion, as to which they received a very general assent, that the cracked bells should be recast. They were sent for that purpose to a well-known English firm. After a time the Committee were informed that four of the eight bells were cracked, and that there was every reason to conclude that the other four soon would crack, as they had the same kind of canons as those which had given way. It was recommended, therefore, that the whole peal should be recast. But when it came to the question of cost, it appeared that this would amount to some 650*l.*, besides cost of carriage, and that, giving credit for 200*l.* worth of bell metal, the net cost to the parish would be above 450*l.*

The question that here arises is, how are the public, or those members of it who have to act on such bodies as church building committees, to know which is the cheapest mode to procure good bells? If we consider that 9*d.* per pound, or 84*l.* per ton, was allowed for the bell-metal, we find the weight of the peal to come out at about 48 cwt. This would make the price of the bells amount to 13*l.* 10*s.* per cwt. This, of course, includes labour and the cost of those appliances for fixing the bells which go with the bells themselves, not including the wooden framework which is fixed in the bell-tower. Still the price seems to me something difficult to understand. The metal we take at 4*l.* 4*s.* per cwt. The ordinary bell-founders charge for casting, I am told by a bell-founder is 2*l.* 2*s.* per cwt. This gives 6*l.* 6*s.* per cwt. for the bells when cast, without fittings. If we compare the price of 2*l.* 2*s.* per cwt. for casting with that paid for casting iron, either in large masses or in small and delicate details, or with that for casting brass and copper articles of various shapes, we shall see that it is, to say the least of it, one allowing a large and liberal profit. "Big Ben" at Westminster weighed, we are told in the "Practical Dictionary of Mechanics," 30,324 lb. Let us call it 252 cwt. Its cost, if I am not misinformed, was 2,000*l.*, fixed complete. This is under 8*l.* per cwt. for an exceptionally costly bell. For, let it be remembered that all the patterns, sweeps, and provisions for casting "Big Ben" had to be made expressly for that purpose, and were unlikely ever again to be required. In the case of a peal of church-bells, everything is ready to hand on the premises of the bell-founders. That, of course, is no reason why they should work for nothing, or for anything short of a fair remuneration. Still, when we compare these three prices of 6*l.* 6*s.*, 8*l.*, and 13*l.* 10*s.* per cwt., I cannot help thinking that there is a disproportionate margin. Can we ascertain how these matters are paid for in Belgium or in Germany, where more general attention is given to the subject of bells than seems to be the case in this country?

The other case occurred in Norfolk. An ancient bell, being cracked, gave forth such a lugubrious sound that it was considered desirable to recast it. A neighbouring nobleman, however, offering to purchase the bell at its worth as metal, the offer was accepted, and 30*l.* was found to be the amount, at 9*d.* per pound. The parish placed this sum in the hands of the rector, to do the best he could with it. Taking advice, he renewed the wooden framing, which was rotten, and fixed a steel bell, with a perfectly satisfactorily result as to tone. The cost altogether of woodwork, bell, and fixing came to under 35*l.*; of which sum 10*l.* went to the carpenter. The figures above given show that the weight of the old bell was 800 lb., or 7·14 cwt.; so that the cost of the new bell fixed was equal to about three-quarters of the value of the old bell as metal.

I do not attempt to offer an opinion as to the tone of steel bells. I am told that it is sweet and clear, and that all that is peculiar to their use is the adoption of an internal spring, to keep the clapper from striking too hard. It has also been stated that steel bars, suspended in a belfry, will give clear musical notes. Perhaps some of our readers may be able to contrast the full, mellow sound of the bell of an old repeater watch with the sharper, but still not unmusical, voice of a modern repeater with steel springs. But the old bells to which I refer were of gold. On the other hand, many of your readers will remember the pure tone of a chime of steel bells exhibited in 1851. With the recent improvements in steel, what change has been made, let me ask, in the sonorous quality of the metal? (if I am allowed to call it a metal).

The questions, then, to which, on behalf of a large *clientèle*, I solicit a reply, are three:—What is the ordinary trade price for recasting bells in England, in Belgium, and in Germany? What would be the charge for the fittings for a peal of eight bells, weighing 48 cwt.? and to what accessible instances of steel bells or of steel bars can we be directed, in order to form an opinion as to the one quality which is that which a neighbourhood requires in a bell,—that is, musical tone? Any one who will give reliable information on this point will entitle himself to the gratitude of a considerable number of persons who are among the best customers of the builder, and wish to be the customers of the bellfounder, when they have a little more information as to the subject of the material and cost of bells.

C. E.

A MONUMENT TO COUTURE.

A MONUMENT has just been raised in Père-la-Chaise cemetery, at Paris, to Couture, the painter, who died last year. It was inaugurated with due solemnity by the Mayor of Senlis, Couture's native town, and by Armand Desmarest. Couture, it may be remembered, was an ardent Republican, and for many years during the Second Empire his pictures never found their way on to the walls of the *Salon*, and he was entirely unrepresented at the Luxembourg Palace! These omissions have, however, long since been rectified. The monument now erected is in the form of a pedestal in black marble, at the top of which is a niche, also in black marble, wherein stands the bust of the painter. Beneath the bust are bas-reliefs of brushes and palette, and small bronze figures, by Barrias, are represented holding scrolls, on which are inscribed the names of Couture's principal works,—the "Décadence des Romains," the "Fauconnier," "L'Amour de l'Or," "La Courtisane," "Horace et Lydie," and the "Volontaires de '92." In the front of the pedestal, Couture's name, and the dates of his birth and death,—1819-1879,—are engraved. The bust of the painter is a reproduction of that which was executed by Clesinger in 1848, the original having been destroyed by the Prussians in 1870, at Couture's house, at Villiers-le-Bel.

The monument raised in Couture's honour may be easily found; it is in the principal avenue of the cemetery, beside the tomb of Ledru-Rollin, and opposite the tombs of the Generals Lecomte and Clément Thomas.

NEW CHURCH IN SOUTHWARK.

THE foundation-stone of the new church of St. Alphege, at the corner of Lancaster-street and King-street, Blackfriars-road, was laid by the Earl of St. Germans on Tuesday last. The church has been designed to give the greatest possible accommodation at the least practicable cost. It has not been arranged with chancel, nave, and aisles upon the usual plan, but it is proposed that the whole area shall be spanned by one roof, and the division of chancel and nave marked by coupled shafts and principals only. The chancel will be well raised from the floor of the nave, the altar-pace being elevated eight steps. A gallery will be provided for children. The peculiar shape of the ground presented some difficulty, but it has been dealt with by arranging for class-rooms, lecture-room, and clergy and choir vestries upon the irregular portion of the site, and it is proposed ultimately to erect a clergy house, with direct access to the church, at the east end of the structure.

The church will be built of red bricks, with Chilmark stone dressings (Scott bed), and will be roofed with slate, as being cheaper than tiles. The cost will probably be about 5,000*l.*

The whole is being erected from the designs, and under the superintendence, of Mr. Robert Willey, architect, Ludgate-hill.

Chelsea.—A movement is stated to be on foot in Chelsea for the formation of a wide thoroughfare, leading, with a curve, from the new houses (built in flats) in Sloane-square to Sydney-place, leading into Onslow-square. Part of the proposed scheme is to lay out the whole of the disused churchyard of St. Luke's, Chelsea, which would be passed *en route*, as a beautiful pleasure-ground. New blocks of buildings are to be erected for the displaced poor. It is further proposed that the scheme should include a wide branch street, running from this new road at the back or on the east side of St. Luke's Church, leading direct rom Sydney-place, Onslow-square, on to the Thames Embankment.

THE COUNCIL'S REPORT: ROYAL INSTITUTE OF BRITISH ARCHITECTS.

THE Report of the Council, 1880, to be laid before the members on the 3rd of May, shows a satisfactory state of things. The three classes of subscribing members are thus tabulated:—

		May, 1878.		May, 1879.		May, 1880.	
Prof.	Fellows (including Life Members)	328	639	339	680	353	719
	Associates	311		341		366	
	Hon. Associates	70		106		114	
	Total	709		786		833	

Of the 339 Fellows at the time of the last annual meeting, three have died, four have resigned, and two have ceased to be members, while twenty-three new Fellows have been elected. Of the 341 Associates at the time of the last annual meeting, two have died, nine have resigned, four have been elected to the class of Fellows, and four have ceased to be members, while forty-four new Associates have been elected. The number of professional members elected during the past official year is thus sixty-seven.

Elaborate statements are given as to the finances, and a scheme is set forth for the examination of candidates for membership, to come into force after May, 1882.

Amongst other matters referring to professional practice, the Council have had under their consideration the "conditions of builders' contracts," which have been strengthened by an additional clause, as follows:—

"Upon every or any such reference the costs of and incidental to the reference and award respectively shall be in the discretion of the referee or arbitrator, who may determine the amount thereof or direct the same to be taxed, as between solicitor and client, or as between party and party, or otherwise, and may award and direct by whom and to whom and in what manner the same shall be borne and paid, and this submission may be made a rule of any division of the High Court of Justice upon the application of either party, who may instruct counsel to consent thereto for the other party without any notice being given to such party."

This clause, prepared in conference with the London Builders' Society, now forms the twenty-first head of the conditions of builders' contracts. A re-issue of the paper has been printed, and copies may now be purchased at the office of the Institute.

We have already given so much space in our present number to proceedings at the Institute that we are unable to say more of the forthcoming Report.

THE BUILDING EXHIBITION AT THE AGRICULTURAL HALL.

WE did not profess to mention all the good things in this exhibition in the notice given by us last week. We now add to what we then said that Messrs. Bromfield, Elliott, & Co. (Stand 39), exhibit a collection of Hodges & Butler's Silicated Stone Paving for footways. The same durable and economical material is used for water-mains, drain-pipes, chimney-flues, sinks, sills, steps, &c. At the same stand Messrs. Banner Brothers' well-known and largely-used sanitary appliances are shown. Smoke is drawn down a 1 in. tube over 60 ft. long, placed as vertically as can be, by the least effort with a Banner cowl. Messrs. Oscar Eklund & Co. (Stand 8) are exhibitors of plasterers' machine-made laths. Visitors should not fail to see in action Mr. Tighe Hamilton's exceedingly ingenious dove-tailing machine, exhibited by Messrs. Powis Bale & Co. (Stand 86). The remarkable feature in the machine is that it operates by the peculiar motion imparted to an ordinary circular saw. The sizes of the tails and pins can be varied from the thickness of the saw up to any dimensions required in practice,—the capacity ranging from the largest constructions down to the finest cabinet work,—whilst in all cases the result appears to be absolutely perfect. The machine effects every known sort of dove-tailing; but can be made of ten different types and forms to secure the special exigencies of different trades in the simplest manner. The Hollington Stone Company (as we mentioned last week) have sent specimens of their material (Stand 31A). It is geologically known as from the white beds of the "Keuper," in the New Red Sandstone formation. It is a very fine sandstone, very soft, easy to work, hardens by exposure, and is believed to be very durable. It is extensively used for important works, and in smoky towns,—such as Sheffield, Birmingham, &c.,—is less affected by the atmosphere than some other stones. Large quantities are sent to London. Mr. A. C. Engert, of the City-road, shows (Stand 116) his patent arrangement of steel plates for the improvement of sound in churches, music-halls, &c. At Stand 41, Messrs. Johnson, Brothers, & Co., of Waterloo-place, exhibit their patent system of glazing.

The Exhibition appears to have been a success, and remains open this Friday and Saturday until ten o'clock at night. It should certainly be visited in the short interval that remains by all who have not yet seen it.

THE TRUST FOR CARRYING ON THE NORTH LONDON COLLEGIATE AND CAMDEN SCHOOL FOR GIRLS.

WE have pleasure in adding to our notice of the schools illustrated in our number of the 10th instant, that the funds for realising the projects of the Governors under the scheme prepared by the Charity Commissioners consist of the following donations, viz.:—

20,000*l.* deposited by the Brewers' Company with the Charity Commissioners.
2,000*l.*, the gift of the same company for scholarships.
6,000*l.*, a loan from the same company from charities of which it is the trustee.
3,000*l.* from the Clothworkers' Company for the hall.
1,000*l.* from Miss Ewart; and various contributions from Miss Buss and her friends.

Some 2,000*l.* or 3,000*l.* are still wanting to complete the works in execution and contemplation.

RESPONSIBILITIES OF LANDLORDS.

ANDERSON AND ANOTHER *v.* OPPENHEIMER.

THIS case, which was heard in the Court of Appeal on the 17th inst., before Lords Justices Brett, Cotton, and Thesiger, was reported in the *Builder* on the occasion of the trial last year (see *Builder*, 1879, p. 839). It was an action by tenants against their landlord for damage caused by bursting of water-pipes, and for breach of a covenant for quiet enjoyment under a lease of certain premises in the City.

The plaintiffs took a lease from the defendant of the ground-floor and basement of Victoria-buildings, Queen Victoria-street, in March, 1873, for a term of twenty-one years, at a yearly rent of 800*l.* The lessor's covenant, in the usual form, was that the lessees should enjoy "without any interruption by the lessor." At the time when the house was built, a large cistern had been placed at the top of it, from which the different tenants were supplied. On the first floor a branch pipe brought the water into a lavatory, where a spring-cock was fixed. After this pipe had been some five years in use, it cracked, and a large quantity of water leaked from it down into the basement and damaged the goods of the plaintiffs. In this action they sought to recover from the landlord the value of their goods so damaged, alleging that he had been guilty of negligence in allowing this branch pipe, which was 18 lb. to 20 lb. weight to the 15 ft., to be used with a spring-cock to which there was no air-chamber. They further alleged that he had neglected to have any stop-cock put to the cistern.

The defendant alleged that the leakage was due to a flaw in the pipe, which he could not have discovered in the exercise of ordinary care. The pipes, &c., however, had been fixed before the lease, and it was contended for the defendant, the lessor, that there was no interruption on his part of the lessees' possession or enjoyment.

Mr. Justice Field, before whom the case was tried, in summing up the case to the jury, told them that the question as to the effect of the implied covenant which had been raised was not one for them; but what they would have to say was whether or not the branch pipe was a reasonably fit and proper one for the purposes for which it had been intended and used, and also whether or not the pipe had been repaired within a reasonable time after notice. The jury answered both questions in the affirmative, and thereupon his Lordship directed a verdict to be entered for the defendant, certifying for a special jury, but reserving the case for further consideration on the point of law. In the result the learned Judge gave judgment for the defendant, and the plaintiff now appealed from that judgment.

The argument for the plaintiffs was that the bursting of the pipe during the lease was the natural result of the insufficiency of the water-pipes put up by the lessor, and, though put up before the lease, the interruption caused thereby happened afterwards.

The argument on the other side was that there was no "interruption by the lessor,"—that is, by an act of his or any person under him.

Lord Justice Brett and Lord Justice Thesiger pointed out to the plaintiffs' counsel that his argument really came to this,—that whenever the pipes in a house burst, the landlord was liable under a covenant for "quiet enjoyment." Even assuming the bursting to be the result of the construction of the pipes, it would be making the covenant retrospective, which had never been held hitherto.

It was admitted by the counsel for the plaintiffs that this was the first case of the kind which had occurred; but still it was urged that in principle it was the same as any action for a breach of the covenant for "quiet enjoyment," since in every case the breach arose from some act done by the lessor before the lease.

The Court, without calling on the counsel for the defendant, affirmed the judgment of the learned judge in his favour.

Lord Justice Brett said, in giving judgment, that the covenant was prospective against any interruption by the lessor or any person claiming under him "during the term," and here there had been no such act during the term. There had been no act by the lessor after the lease; the only act done by him was done before the lease, and, as the jury found, done quite lawfully and not negligently; and the disaster was entirely owing to the "forces of nature," and not to any fault of the defendant, and so there was no cause of action.

Lords Justices Cotton and Thesiger concurred.

THE PUBLIC RECORD OFFICE, LONDON.

SIR,—The very interesting and valuable article on the Public Record Office, London, which was printed in the *Builder* of the 3rd inst., has, I am pleased to tell you, not only been very widely noticed by the press, but has been very extensively read by a large number of literary men, and they all hope the grievances therein set forth will soon be remedied. But the writer of the article, although evidently no novice in the art of searching out the "mysteries of the Rolls," has omitted to tell your readers a few other grievances which, when "the house" is set in order, it is necessary should be attended to, if the public convenience is studied, as I presume, on the opening of the Record Office, it was intended should be the case.

At the British Museum, a book or two is written for on a signed-ticket, and when the article is returned the ticket is given back to the searcher as his receipt. If he wishes the book or MS. kept out for him, the same ticket can be used by the reader the next day; the only difference being that on each day it is stamped with the date, and the same ticket can be used for six days. But at Fetter-lane they adopt quite another principle: they not only keep the MS., but also the ticket, and compel a fresh ticket to be used every day; the result being that the searcher has no evidence that he has returned the document; and should at any time a clerk there make an omission to record its return, there is no other course open to the Master of the Rolls but to charge the reader with having stolen the MS.! But, in order to catch the thief at some time or other, the office, in its wisdom, compels every person entering the building to sign in full his or her name and address,—it matters very little to the official whether they are known to be daily attendants or not,—as extraordinary a proceeding as it is useless. It is useless for the officials to say there is no chance of a mistake,—the public has to be studied as much as them; and why place in the hands of a clerk such terrible odds against the public? The ticket business might be conducted on the same principle it is at the British Museum. Every one's time would be saved, the public money (used in new tickets) would be saved, and the searchers feel confident that the MS. has been returned to its proper place.

Then, again, your article tells us the delivery of the MS. takes a little too long a time. Your writer is too mild—the time taken is nothing more or less than outrageous. It often occurs that a searcher has to wait at least an hour or more, and he has even been told, if in a hurry, they would have it ready for him on the following morning, to suit the searcher's convenience, of course, and not their own! The staff is not sufficiently strong enough, is the answer. All I have to say is, where does the money (a grant of many thousands) go to? Is it in permitting so many assistants to help each other in attending to Government-office searchers, while the public in this public depository have to wait? The number of officials paid to look after these documents ought to be sufficient, not only to produce them in at least a quarter of an hour to the public after written for, but also to attend on them almost man for man. The expense of calendering is not to be begrudged, because good work is done,—although it takes a long time to do it,—and instant production of the MS. required should be the case, if this work were properly done.

I have been an occasional searcher at the Record Office for some time. I quite agree with your article that the want of light on dark days is very badly felt, and totally upsets its name as a public building; for all the public buildings now provide gas, and even the British Museum has exhibited its share of "progress" as regards a light. I am told that a memorial was sent to the Master of the Rolls in January

or February last (during the dark days), signed by all the regular searchers, asking for artificial light of some kind, and I am told that, even candles, although pretty freely in use elsewhere in the building, would not be objected to by the readers, but it is considered by those more likely to know than the officials that gas would be safer. I understand this memorial was duly considered by, if not the Master, by some persons in authority, and, acting on the spirit of by-gone ages, refused. As your writer remarks, the reason assigned is the absurd theory the danger it would be to the records, the writer of the reply forgetting perhaps to remember that the building is brick and stone, and that the gas was freely burnt where what you describe as that "trifle" the Domesday Book, the most valuable record in the kingdom, is preserved! As your writer does not tell your readers the fact that this application was actually made, it may interest your readers to know that the Public Record Office in Fetter-lane has not yet finally forgotten the good old times when officials could do as they liked and the world outside could not help themselves. But I think those times should be forgotten whenever the public convenience, and those who pay for that convenience, are concerned. The officials, I believe, are under the impression that if gas is introduced into the search rooms it will necessitate gas being used in the cupboards and other nooks and corners, and, what is to them of more consequence, the keeping open of the building beyond the old-fashioned time,—ten to four. If officialism is to make constructions out of no actual fact then all I can say is, preserve us from their authority as soon as possible.

As an Englishman, and one who highly values the national records, I am very sorry indeed to know that it has been necessary to publish the deplorable shortcomings of the great English Record Office to the world; and I hope that the authorities of Moscow, in their new building (engraved appositely enough in your number of the 3rd inst., which describes the London office) will take a hint, and serve their literary searchers better than we do here.

It is yet time, however, to remedy the evils I speak of. If the Master of the Rolls is powerless, perhaps H. M. Commissioners of Public Buildings will inaugurate "the turn of the tide" by conferring a great blessing on each of those who, like myself, is, and may become,

A Reader of the Rolls.

MISAPPROPRIATED DESIGN.

Sir,—My attention having been drawn to the fact that Mr. Tall, a builder in concrete, is exhibiting at his Stand at the Building Exhibition at Islington some drawings for a concrete house, endorsed "J. Tall, Architect," I shall be much obliged if you will allow me to state through your columns that they are copies of a design that I made last year for a house proposed to be erected at Reigate, and that Mr. Tall has not taken any notice of a letter I addressed him on the 15th inst., calling his attention to the fact, and requesting him to desist from exhibiting or claiming the design as his own.

Percy Hunter.

GAS ENGINES FOR COUNTRY RESIDENCES.

Sir,—In the *Builder* of the 17th inst. mention is made of the economical raising of water. It may be of further interest to know that the "Otto" gas-engine can raise 1,560 gallons of water 100 ft. high for the sum of 1d. in and near London.

Besides its superior economy, the gas-engine has an immense advantage over other engines, inasmuch as it can be started at full power at a moment's notice. This advantage renders the "Otto" gas-engine invaluable as a fire-engine in country residences and other isolated buildings where a supply of ordinary lighting-gas can be obtained. With a suitable arrangement of pumps the engine can be used daily for raising water to supply the house and garden, and can be started at a moment's notice to throw a large body of water where desired in the event of a fire breaking out. Not less important than a good supply of pure water is an ample supply of fresh air, the want of which is even more felt than the other in many mansions. Hitherto the difficulty has been in obtaining a suitable motor for driving a fan for exhausting the vitiated air, or for drawing pure air into the rooms, from the most suitable side of the building, according to the season or time of day. The use of a steam-engine, with its boiler, can in many cases not be entertained. Apart from the risk of a boiler explosion, and the constant attendance required, the smoke and dirt from the boiler-furnace and chimney falling upon the flowers and grass, and spoiling the rain-water collected from the roof, render the boiler an intolerable nuisance. Now that the "Otto" gas-engine has proved itself such a marvellous success, having all the advantages of a steam-engine without any of the drawbacks of the boiler, the difficulty in the way of providing a suitable motor for country residences no longer exists.

After the blessings of pure water and fresh air comes that of clean linen. The handiness and cleanliness of the "Otto" gas-engine render it the most suitable motor yet tried for laundry work. Its readiness for starting at any time also renders it a great favourite for organ-blowing and other intermittent work.

So great has been the success of this engine in such buildings as St. Paul's and Salisbury Cathedrals; the Royal Laundry, Richmond; the Royal Society, Royal Institution, &c., that it may safely be said the time is not far distant when no building of any pretensions, whether palace, mansion, or warehouse, will be considered complete without a gas-engine. Robert Wilson.

*** We print this letter because, from what we have personally seen and heard of the "Otto" gas-engine, we think its qualities ought to be widely known.

THE TAY BRIDGE CALAMITY.

Sir,—After the recent startling evidence in connexion with this inquiry, a considerable amount of interest attaches to the following questions:—

1. Was the work executed under a contract amount?
2. How many competing tenders were received?
3. What were the amounts?

Can any one furnish answers to these questions, which I do not think, even under the present circumstances of the case, can be considered to prejudice the matter on either side. C. W. B.

CHURCH-BUILDING NEWS.

Plymouth.—The foundation-stone of the new Church of St. Peter, Plymouth, was laid on the 1st inst. by the Earl of Devon. The church will stand on the site of a building which was begun in 1828, and consecrated in October, 1850. During recent years the congregation has grown to such an extent that the want of additional accommodation has been much felt. In 1878, however, a sum of 6,000*l.* was given by two ladies of the congregation towards repairing the nave of the edifice; and in the following year the relatives of those ladies contributed a further sum of 1,000*l.* This placed the congregation in a position to undertake the work so long and so earnestly desired, the remaining sum of money required for rebuilding the structure being soon forthcoming. Upon plans prepared by Mr. G. H. Fellowes Prynne, the son of the vicar, nearly the whole of the old edifice has been removed, and upon the site will be erected a commodious church in the Early Pointed style. The sanctuary and vestry of the old building are the only parts that have been retained. The interior will be of blue limestone and Bath stone, with windows of Beer stone and Doulting, whilst Doulting will also be used in the exterior work. The tower will be situated at the west end of the main entrance, and will be 124 ft. high and 32 ft. square. A *flèche* will be carried up from the roof at the junction of the chancel and the nave, and will contain a bell. One unusual feature in the structure is a double transept with two rows of windows, the object being to enable part of the organ to be carried on a second floor. The length of the edifice from the tower to the east end will be 100 ft., and the height of nave to the interior of the barrel-roof 60 ft. It is intended that there shall be no pews, but that only chairs shall be used. Sitting accommodation of this character will be provided for 1,000 persons, but there will be room for the provision of extra seats to accommodate in all nearly 1,200 persons. The old fabric accommodated only a little over 700 worshippers. Difficulties having arisen with the builder who accepted the original contract, the work has been undertaken by Mr. A. Guy, of London. The expense involved in carrying out the plans so far as intended is estimated at between 10,000*l.* and 12,000*l.*, but to carry out the designs in their completeness an outlay of from 13,000*l.* to 14,000*l.* will be required.

Old Kea.—In a little valley sloping towards the estuary of the Fal, in Cornwall, there rises a church tower from which is obtained a view of Lord Falmouth's mansion of Tregothnan on the other side of the river. From the river the pinnacles of this tower appear, one by one, over the brow of the hill, and have suggested the not very poetical simile of old women running over the hill for a pinch of snuff. Such, at all events, is the local tradition. But to this old tower there is no church attached. In the early years of the present century the church was pulled down, and some of its materials were used for building a new church in a more central part of the parish. In 1804, so runs the record, a poor-house was erected by the parish within the sacred enclosure; but when that fell into disuse, a subsequent curate in charge, the Rev. J. W. Murray, now of St. Enoder, conceived the idea of turning it into a mission chapel for that part of the parish, and, by adding a little chancel and a south aisle, he has now carried out his plans. The work was done, from drawings gratuitously supplied by Mr. E. F. Ralling, architect, London, by Mr. C. Buzza, of Truro.

COLONIAL CHURCH-BUILDING NEWS.

South India.—It may have been noticed by our readers that one of the three recently-consecrated colonial bishops in St. Paul's Cathedral, in July last, was the Rev. J. M. Speechly, D.D., as first bishop of Travancore and Cochin, who left England for his diocese in December of last year. The bishop took with him plans for his proposed future church, to be called Christchurch Cathedral Church, and it is proposed to so alter and enlarge the existing church of Cottyam as to give it the proper type of a cathedral church. We believe this church was designed by a military engineer, and built some time back. It consists of a nave, 90 ft. by 30 ft. 5 in.; north and south aisles, 14 ft. 9 in. wide; western tower, 15 ft. square; and chancel, 20 ft. square. It is anything but ornate in design. The nave and aisles are under one roof. The proposed alterations consist in throwing out transepts the width of the two last bays of the nave, 15 ft. deep; taking down the present chancel; forming a new chancel arch, and building a choir 20 ft. long, and a chancel having a circular apse 25 ft. long, both being the same width as the present nave. An arch on corbels will divide the chancel from the choir. On the north side of the choir will be built the sacristies, 20 ft. by 15 ft., and on the south side a choir aisle, 20 ft. by 15 ft. Thus the plan will be cruciform. In the elevations all the present windows, doorways, &c., will be taken out, and reinstated with others. The roof over the nave and aisles will be taken off, and a clearstory built, lighted by lancet windows in couplets. The transepts will be lighted north and south by three long lancet windows, and the clearstory windows will run round the same east and west. The aisles will have lean-to roofs, and be lighted by three-light Early Geometrical windows. In the south transept, under the lancet windows, a large double doorway will be formed, with moulded arches on caps and shafts, &c. The buttresses will be cut down and have new weatherings. The tower will be heightened, and ringing-loft and belfry added; it will terminate with a battlemented top and low-pitched roof. The new apsidal chancel will be lighted by three long lancet windows. The ridges of all main roofs will run level throughout. The whole of the floors will be laid with tiles. The choir will be divided from the nave by an open screen and gates; on it on either side will be the stalls, and choir seats and desks, the bishop's throne being placed on the south side next the chancel. The choir will be separated from the choir aisle and sacristies by open arches, filled in with screens of wrought iron and brasswork. From the chancel to the sacristies will be formed a passage-way, and on the south side will be placed a sedilia, credence, &c. The altar will be raised seven steps from the nave level. The whole of the walls will be built with native stone. The nave roof will be open-timbered, with tie-beams, that of the choir and chancel match-boarded in panels. The designs have been prepared by the architect, Mr. R. Speechly, brother of the new bishop.

Books.

The American House Carpenter: A Treatise on the Art of Building, comprising Styles of Architecture, Strength of Materials, &c.; together with a Compend of Mathematics. By R. G. Hatfield, Architect. New York: Wiley & Sons. London: Trübner & Co. 1880.

The leading title of this book is not exactly in accordance with its contents, since it treats of a good deal besides house-carpentry, and there is nothing specially American in the theory or practice laid down. From the very voluminous title-page, only a small portion of which we have space to quote, we learn that its author was a Fellow of the American Institute of Architects and author of a work on Transverse Strains. He is now deceased, and the present edition of the work, the eighth (but possibly the first that has been published in England also), is edited by Mr. O. P. Hatfield, also a member of the American Institute.

The book is a very voluminous one, and commences with a short treatise on architecture generally, intended rather to awaken the interest of the student in the general subject of building than to be a complete guide to the historical study of architecture; a little gilding, in fact, to give more attractiveness to a book

THE COUNCIL'S REPORT: ROYAL INSTITUTE OF BRITISH ARCHITECTS.

THE Report of the Council, 1880, to be laid before the members on the 3rd of May, shows a satisfactory state of things. The three classes of subscribing members are thus tabulated:—

		May, 1878.		May, 1879.		May, 1880.	
Prof.	Fellows (including Life Members)	328	639	339	680	353	719
	Associates	311		341		366	
	Hon. Associates	70		100		114	
	Total	709		786		833	

Of the 339 Fellows at the time of the last annual meeting, three have died, four have resigned, and two have ceased to be members, while twenty-three new Fellows have been elected. Of the 341 Associates at the time of the last annual meeting, two have died, nine have resigned, four have been elected to the class of Fellows, and four have ceased to be members, while forty-four new Associates have been elected. The number of professional members elected during the past official year is thus sixty-seven.

Elaborate statements are given as to the finances, and a scheme is set forth for the examination of candidates for membership, to come into force after May, 1882.

Amongst other matters referring to professional practice, the Council have had under their consideration the "conditions of builders' contracts," which have been strengthened by an additional clause, as follows:—

"Upon every or any such reference the costs of and incidental to the reference and award respectively shall be in the discretion of the referee or arbitrator, who may determine the amount thereof or direct the same to be taxed, as between solicitor and client, or as between party and party, or otherwise, and may award and direct by whom and to whom and in what manner the same shall be borne and paid, and this submission may be made a rule of any division of the High Court of Justice upon the application of either party, who may instruct counsel to consent thereto for the other party without any notice being given to such party."

This clause, prepared in conference with the London Builders' Society, now forms the twenty-first head of the conditions of builders' contracts. A re-issue of the paper has been printed, and copies may now be purchased at the office of the Institute.

We have already given so much space in our present number to proceedings at the Institute that we are unable to say more of the forthcoming Report.

THE BUILDING EXHIBITION AT THE AGRICULTURAL HALL.

WE did not profess to mention all the good things in this exhibition in the notice given by us last week. We now add to what we then said that Messrs. Bromfield, Elliott, & Co. (Stand 39), exhibit a collection of Hodges & Butler's Silicated Stone Paving for footways. The same durable and economical material is used for water-mains, drain-pipes, chimney-flues, sinks, sills, steps, &c. At the same stand Messrs. Banner Brothers' well-known and largely-used sanitary appliances are shown. Smoke is drawn down a 1 in. tube over 60 ft. long, placed as vertically as can be, by the least effort with a Banner cowl. Messrs. Oscar Eklund & Co. (Stand 8) are exhibitors of plasterers' machine-made laths. Visitors should not fail to see in action Mr. Tighe Hamilton's exceedingly ingenious dove-tailing machine, exhibited by Messrs. Powis Bale & Co. (Stand 86). The remarkable feature in the machine is that it operates by the peculiar motion imparted to an ordinary circular saw. The sizes of the tails and pins can be varied from the thickness of the saw up to any dimensions required in practice,—the capacity ranging from the largest constructions down to the finest cabinet work,—whilst in all cases the result appears to be absolutely perfect. The machine effects every known sort of dove-tailing; but can be made of ten different types and forms to secure the special exigencies of different trades in the simplest manner. The Hollington Stone Company (as we mentioned last week) have sent specimens of their material (Stand 31A). It is geologically known as from the white beds of the "Keuper," in the New Red Sandstone formation. It is a very fine sandstone, very soft, easy to work, hardens by exposure, and is believed to be very durable. It is extensively used for important works, and in smoky towns,—such as Sheffield, Birmingham, &c.,—is less affected by the atmosphere than some other stones. Large quantities are sent to London. Mr. A. C. Engert, of the City-road, shows (Stand 116) his patent arrangement of steel plates for the improvement of sound in churches, music-halls, &c. At Stand 41, Messrs. Johnson, Brothers, & Co., of Waterloo-place, exhibit their patent system of glazing.

The Exhibition appears to have been a success, and remains open this Friday and Saturday until ten o'clock at night. It should certainly be visited in the short interval that remains by all who have not yet seen it.

THE TRUST FOR CARRYING ON THE NORTH LONDON COLLEGIATE AND CAMDEN SCHOOL FOR GIRLS.

WE have pleasure in adding to our notice of the schools illustrated in our number of the 10th instant, that the funds for realising the projects of the Governors under the scheme prepared by the Charity Commissioners consist of the following donations, viz.:—

20,000*l.* deposited by the Brewers' Company with the Charity Commissioners.
2,000*l.*, the gift of the same company for scholarships.
6,000*l.*, a loan from the same company from charities of which it is the trustee.
3,000*l.* from the Clothworkers' Company for the hall.
1,000*l.* from Miss Ewart; and various contributions from Miss Buss and her friends.

Some 2,000*l.* or 3,000*l.* are still wanting to complete the works in execution and contemplation.

RESPONSIBILITIES OF LANDLORDS.

ANDERSON AND ANOTHER *v.* OPPENHEIMER.

THIS case, which was heard in the Court of Appeal on the 17th inst., before Lords Justices Brett, Cotton, and Thesiger, was reported in the *Builder* on the occasion of the trial last year (see *Builder*, 1879, p. 839). It was an action by tenants against their landlord for damage caused by bursting of water-pipes, and for breach of a covenant for quiet enjoyment under a lease of certain premises in the City.

The plaintiffs took a lease from the defendant of the ground-floor and basement of Victoria-buildings, Queen Victoria-street, in March, 1873, for a term of twenty-one years, at a yearly rent of 800*l.* The lessor's covenant, in the usual form, was that the lessees should enjoy "without any interruption by the lessor." At the time when the house was built, a large cistern had been placed at the top of it, from which the different tenants were supplied. On the first floor a branch pipe brought the water into a lavatory, where a spring-cock was fixed. After this pipe had been some five years in use, it cracked, and a large quantity of water leaked from it down into the basement and damaged the goods of the plaintiffs. In this action they sought to recover from the landlord the value of their goods so damaged, alleging that he had been guilty of negligence in allowing this branch pipe, which was 18 lb. to 20 lb. weight to the 15 ft., to be used with a spring-cock to which there was no air-chamber. They further alleged that he had neglected to have any stop-cock put to the cistern.

The defendant alleged that the leakage was due to a flaw in the pipe, which he could not have discovered in the exercise of ordinary care. The pipes, &c., however, had been fixed before the lease, and it was contended for the defendant, the lessor, that there was no interruption on his part of the lessees' possession or enjoyment.

Mr. Justice Field, before whom the case was tried, in summing up the case to the jury, told them that the question as to the effect of the implied covenant which had been raised was not one for them; but what they would have to say was whether or not the branch pipe was a reasonably fit and proper one for the purposes for which it had been intended and used, and also whether or not the pipe had been repaired within a reasonable time after notice. The jury answered both questions in the affirmative, and thereupon his Lordship directed a verdict to be entered for the defendant, certifying for a special jury, but reserving the case for further consideration on the point of law. In the result the learned Judge gave judgment for the defendant, and the plaintiff now appealed from that judgment.

The argument for the plaintiffs was that the bursting of the pipe during the lease was the natural result of the insufficiency of the water-pipes put up by the lessor, and, though put up before the lease, the interruption caused thereby happened afterwards.

The argument on the other side was that there was no "interruption by the lessor,"—that is, by an act of his or any person under him.

Lord Justice Brett and Lord Justice Thesiger pointed out to the plaintiffs' counsel that his argument really came to this,—that whenever the pipes in a house burst, the landlord was liable under a covenant for "quiet enjoyment." Even assuming the bursting to be the result of the construction of the pipes, it would be making the covenant retrospective, which had never been held hitherto.

It was admitted by the counsel for the plaintiffs that this was the first case of the kind which had occurred; but still it was urged that in principle it was the same as any action for a breach of the covenant for "quiet enjoyment," since in every case the breach arose from some act done by the lessor before the lease.

The Court, without calling on the counsel for the defendant, affirmed the judgment of the learned judge in his favour.

Lord Justice Brett said, in giving judgment, that the covenant was prospective against any interruption by the lessor or any person claiming under him "during the term," and here there had been no such act during the term. There had been no act by the lessor after the lease; the only act done by him was done before the lease, and, as the jury found, done quite lawfully and not negligently; and the disaster was entirely owing to the "forces of nature," and not to any fault of the defendant, and so there was no cause of action.

Lords Justices Cotton and Thesiger concurred.

THE PUBLIC RECORD OFFICE, LONDON.

SIR,—The very interesting and valuable article on the Public Record Office, London, which was printed in the *Builder* of the 3rd inst., has, I am pleased to tell you, not only been very widely noticed by the press, but has been very extensively read by a large number of literary men, and they all hope the grievances therein set forth will soon be remedied. But the writer of the article, although evidently no novice in the art of searching out the "mysteries of the Rolls," has omitted to tell your readers a few other grievances which, when "the house" is set in order, it is necessary should be attended to, if the public convenience is studied, as I presume, on the opening of the Record Office, it was intended should be the case.

At the British Museum, a book or two is written for on a signed-ticket, and when the article is returned the ticket is given back to the searcher as his receipt. If he wishes the book or MS. kept out for him, the same ticket can be used by the reader the next day; the only difference being that on each day it is stamped with the date, and the same ticket can be used for six days. But at Fetter-lane they adopt quite another principle: they not only keep the MS., but also the ticket, and compel a fresh ticket to be used every day; the result being that the searcher has no evidence that he has returned the document; and should at any time a clerk there make an omission to record its return, there is no other course open to the Master of the Rolls but to charge the reader with having stolen the MS.! But, in order to catch the thief at some time or other, the office, in its wisdom, compels every person entering the building to sign in full his or her name and address,—it matters very little to the official whether they are known to be daily attendants or not,—as extraordinary a proceeding as it is useless. It is useless for the officials to say there is no chance of a mistake,—the public has to be studied as much as them; and why place in the hands of a clerk such terrible odds against the public? The ticket business might be conducted on the same principle it is at the British Museum. Every one's time would be saved, the public money (used in new tickets) would be saved, and the searchers feel confident that the MS. has been returned to its proper place.

Then, again, your article tells us the delivery of the MS. takes a little too long a time. Your writer is too mild—the time taken is nothing more or less than outrageous. It often occurs that a searcher has to wait at least an hour or more, and he has even been told, if in a hurry, they would have it ready for him on the following morning, to suit the searcher's convenience, of course, and not their own! The staff is not sufficiently strong enough, is the answer. All I have to say is, where does the money (a grant of many thousands) go to? Is it in permitting so many assistants to help each other in attending to Government-office searchers, while the public in this public depository have to wait? The number of officials paid to look after these documents ought to be sufficient, not only to produce them in at least a quarter of an hour to the public after written for, but also to attend on them almost man for man. The expense of calendering is not to be begrudged, because good work is done,—although it takes a long time to do it,—and instant production of the MS. required should be the case, if this work were properly done.

I have been an occasional searcher at the Record Office for some time. I quite agree with your article that the want of light on dark days is very badly felt, and totally upsets its name as a public building; for all the public buildings now provide gas, and even the British Museum has exhibited its share of "progress" as regards a light. I am told that a memorial was sent to the Master of the Rolls in January

or February last (during the dark days), signed by all the regular searchers, asking for artificial light of some kind, and I am told that, even candles, although pretty freely in use elsewhere in the building, would not be objected to by the readers, but it is considered by those more likely to know than the officials that gas would be safer. I understand this memorial was duly considered by, if not the Master, by some persons in authority, and, acting on the spirit of by-gone ages, refused. As your writer remarks, the reason assigned is the absurd theory the danger it would be to the records, the writer of the reply forgetting perhaps to remember that the building is brick and stone, and that the gas was freely burnt where what you describe as that "trifle" the Domesday Book, the most valuable record in the kingdom, is preserved! As your writer does not tell your readers the fact that this application was actually made, it may interest your readers to know that the Public Record Office in Fetter-lane has not yet finally forgotten the good old times when officials could do as they liked and the world outside could not help themselves. But I think those times should be forgotten whenever the public convenience, and those who pay for that convenience, are concerned. The officials, I believe, are under the impression that if gas is introduced into the search rooms it will necessitate gas being used in the cupboards and other nooks and corners, and, what is to them of more consequence, the keeping open of the building beyond the old-fashioned time,—ten to four. If officialism is to make constructions out of no actual fact then all I can say is, preserve us from their authority as soon as possible.

As an Englishman, and one who highly values the national records, I am very sorry indeed to know that it has been necessary to publish the deplorable shortcomings of the great English Record Office to the world; and I hope that the authorities of Moscow, in their new building (engraved appositely enough in your number of the 3rd inst., which describes the London office) will take a hint, and serve their literary searchers better than we do here.

It is yet time, however, to remedy the evils I speak of. If the Master of the Rolls is powerless, perhaps H. M. Commissioners of Public Buildings will inaugurate "the turn of the tide" by conferring a great blessing on each of those who, like myself, is, and may become,

A Reader of the Rolls.

MISAPPROPRIATED DESIGN.

Sir,—My attention having been drawn to the fact that Mr. Tall, a builder in concrete, is exhibiting at his Stand at the Building Exhibition at Islington some drawings for a concrete house, endorsed "J. Tall, Architect," I shall be much obliged if you will allow me to state through your columns that they are copies of a design that I made last year for a house proposed to be erected at Reigate, and that Mr. Tall has not taken any notice of a letter I addressed him on the 15th inst., calling his attention to the fact, and requesting him to desist from exhibiting or claiming the design as his own.

Percy Hunter.

GAS ENGINES FOR COUNTRY RESIDENCES.

Sir,—In the *Builder* of the 17th inst. mention is made of the economical raising of water. It may be of further interest to know that the "Otto" gas-engine can raise 1,500 gallons of water 100 ft. high for the sum of 1d. in and near London.

Besides its superior economy, the gas-engine has an immense advantage over other engines, inasmuch as it can be started at full power at a moment's notice. This advantage renders the "Otto" gas-engine invaluable as a fire-engine in country residences and other isolated buildings where a supply of ordinary lighting-gas can be obtained. With a suitable arrangement of pumps the engine can be used daily for raising water to supply the house and garden, and can be started at a moment's notice to throw a large body of water where desired in the event of a fire breaking out. Not less important than a good supply of pure water is an ample supply of fresh air, the want of which is even more felt than the other in many mansions. Hitherto the difficulty has been in obtaining a suitable motor for driving a fan for exhausting the vitiated air, or for drawing pure air into the rooms, from the most suitable side of the building, according to the season or time of day. The use of a steam-engine, with its boiler, can in many cases not be entertained. Apart from the risk of a boiler explosion, and the constant attendance required, the smoke and dirt from the boiler-furnace and chimney falling upon the flowers and grass, and spoiling the rain-water collected from the roof, render the boiler an intolerable nuisance. Now that the "Otto" gas-engine has proved itself such a marvellous success, having all the advantages of a steam-engine without any of the drawbacks of the boiler, the difficulty in the way of providing a suitable motor for country residences no longer exists.

After the blessings of pure water and fresh air comes that of clean linen. The handiness and cleanliness of the "Otto" gas-engine render it the most suitable motor yet tried for laundry work. Its readiness for starting at any time also renders it a great favourite for organ-blowing and other intermittent work.

So great has been the success of this engine in such buildings as St. Paul's and Salisbury Cathedrals; the Royal Laundry, Richmond; the Royal Society, Royal Institution, &c., that it may safely be said the time is not far distant when no building of any pretensions, whether palace, mansion, or warehouse, will be considered complete without a gas-engine.

Robert Wilson.

*** We print this letter because, from what we have personally seen and heard of the "Otto" gas-engine, we think its qualities ought to be widely known.

THE TAY BRIDGE CALAMITY.

Sir,—After the recent startling evidence in connexion with this inquiry, a considerable amount of interest attaches to the following questions:—

1. Was the work executed under a contract amount?
2. How many competing tenders were received?
3. What were the amounts?

Can any one furnish answers to these questions, which I do not think, even under the present circumstances of the case, can be considered to prejudice the matter on either side.

C. W. B.

CHURCH-BUILDING NEWS.

Plymouth.—The foundation-stone of the new Church of St. Peter, Plymouth, was laid on the 1st inst. by the Earl of Devon. The church will stand on the site of a building which was begun in 1828, and consecrated in October, 1850. During recent years the congregation has grown to such an extent that the want of additional accommodation has been much felt. In 1878, however, a sum of 6,000*l.* was given by two ladies of the congregation towards repairing the nave of the edifice; and in the following year the relatives of those ladies contributed a further sum of 1,000*l.* This placed the congregation in a position to undertake the work so long and so earnestly desired, the remaining sum of money required for rebuilding the structure being soon forthcoming. Upon plans prepared by Mr. G. H. Fellowes Prynne, the son of the vicar, nearly the whole of the old edifice has been removed, and upon the site will be erected a commodious church in the Early Pointed style. The sanctuary and vestry of the old building are the only parts that have been retained. The interior will be of blue limestone and Bath stone, with windows of Beer stone and Doulting, whilst Doulting will also be used in the exterior work. The tower will be situated at the west end of the main entrance, and will be 124 ft. high and 32 ft. square. A *flèche* will be carried up from the roof at the junction of the chancel and the nave, and will contain a bell. One unusual feature in the structure is a double transept with two rows of windows, the object being to enable part of the organ to be carried on a second floor. The length of the edifice from the tower to the east end will be 100 ft., and the height of nave to the interior of the barrel-roof 60 ft. It is intended that there shall be no pews, but that only chairs shall be used. Sitting accommodation of this character will be provided for 1,000 persons, but there will be room for the provision of extra seats to accommodate in all nearly 1,200 persons. The old fabric accommodated only a little over 700 worshippers. Difficulties having arisen with the builder who accepted the original contract, the work has been undertaken by Mr. A. Guy, of London. The expense involved in carrying out the plans so far as intended is estimated at between 10,000*l.* and 12,000*l.*, but to carry out the designs in their completeness an outlay of from 13,000*l.* to 14,000*l.* will be required.

Old Kea.—In a little valley sloping towards the estuary of the Fal, in Cornwall, there rises a church tower from which is obtained a view of Lord Falmouth's mansion of Tregothnan on the other side of the river. From the river the pinnacles of this tower appear, one by one, over the brow of the hill, and have suggested the not very poetical simile of old women running over the hill for a pinch of snuff. Such, at all events, is the local tradition. But to this old tower there is no church attached. In the early years of the present century the church was pulled down, and some of its materials were used for building a new church in a more central part of the parish. In 1804, so runs the record, a poor-house was erected by the parish within the sacred enclosure; but when that fell into disuse, a subsequent curate in charge, the Rev. J. W. Murray, now of St. Enoder, conceived the idea of turning it into a mission chapel for that part of the parish, and, by adding a little chancel and a south aisle, he has now carried out his plans. The work was done, from drawings gratuitously supplied by Mr. E. F. Ralling, architect, London, by Mr. C. Buzza, of Truro.

COLONIAL CHURCH-BUILDING NEWS.

South India.—It may have been noticed by our readers that one of the three recently-consecrated colonial bishops in St. Paul's Cathedral, in July last, was the Rev. J. M. Speechly, D.D., as first bishop of Travancore and Cochin, who left England for his diocese in December of last year. The bishop took with him plans for his proposed future church, to be called Christchurch Cathedral Church, and it is proposed to so alter and enlarge the existing church of Cottyam as to give it the proper type of a cathedral church. We believe this church was designed by a military engineer, and built some time back. It consists of a nave, 90 ft. by 30 ft. 5 in.; north and south aisles, 14 ft. 9 in. wide; western tower, 15 ft. square; and chancel, 20 ft. square. It is anything but ornate in design. The nave and aisles are under one roof. The proposed alterations consist in throwing out transepts the width of the two last bays of the nave, 15 ft. deep; taking down the present chancel; forming a new chancel arch, and building a choir 20 ft. long, and a chancel having a circular apse 25 ft. long, both being the same width as the present nave. An arch on corbels will divide the chancel from the choir. On the north side of the choir will be built the sacristies, 20 ft. by 15 ft., and on the south side a choir aisle, 20 ft. by 15 ft. Thus the plan will be cruciform. In the elevations all the present windows, doorways, &c., will be taken out, and reinstated with others. The roof over the nave and aisles will be taken off, and a clearstory built, lighted by lancet windows in couplets. The transepts will be lighted north and south by three long lancet windows, and the clearstory windows will run round the same east and west. The aisles will have lean-to roofs, and be lighted by three-light Early Geometrical windows. In the south transept, under the lancet windows, a large double doorway will be formed, with moulded arches on caps and shafts, &c. The buttresses will be cut down and have new weatherings. The tower will be heightened, and ringing-loft and belfry added; it will terminate with a battlemented top and low-pitched roof. The new apsidal chancel will be lighted by three long lancet windows. The ridges of all main roofs will run level throughout. The whole of the floors will be laid with tiles. The choir will be divided from the nave by an open screen and gates; on it on either side will be the stalls, and choir seats and desks, the bishop's throne being placed on the south side next the chancel. The choir will be separated from the choir aisle and sacristies by open arches, filled in with screens of wrought iron and brasswork. From the chancel to the sacristies will be formed a passage-way, and on the south side will be placed a sedilia, credence, &c. The altar will be raised seven steps from the nave level. The whole of the walls will be built with native stone. The nave roof will be open-timbered, with tie-beams, that of the choir and chancel match-boarded in panels. The designs have been prepared by the architect, Mr. R. Speechly, brother of the new bishop.

Books.

The American House Carpenter: A Treatise on the Art of Building, comprising Styles of Architecture, Strength of Materials, &c.; together with a Compend of Mathematics. By R. G. Hatfield, Architect. New York: Wiley & Sons. London: Trübner & Co. 1880.

The leading title of this book is not exactly in accordance with its contents, since it treats of a good deal besides house-carpentry, and there is nothing specially American in the theory or practice laid down. From the very voluminous title-page, only a small portion of which we have space to quote, we learn that its author was a Fellow of the American Institute of Architects and author of a work on Transverse Strains. He is now deceased, and the present edition of the work, the eighth (but possibly the first that has been published in England also), is edited by Mr. O. P. Hatfield, also a member of the American Institute.

The book is a very voluminous one, and commences with a short treatise on architecture generally, intended rather to awaken the interest of the student in the general subject of building than to be a complete guide to the historical study of architecture; a little gilding, in fact, to give more attractiveness to a book

the bulk of which deals with very practical matters. From an English architect's point of view the introduction had been better omitted; it may pass muster in America, but many of the remarks in it show a very imperfect grasp of the subject,—a deficiency we are not disposed to charge upon the author himself so much as on the generally deficient standard of information and critical judgment in regard to the past styles of architecture which still seems to be accepted as sufficient on the other side of the Atlantic. It is difficult, of course, for European architects to put themselves in the position of those who inhabit a country where there is no old architecture, and who are so comparatively far out of the way of seeing and studying the remains of such architecture; but we should have thought that American architects might have attained sufficient knowledge of the ancient styles and of architectural history through the medium of the many books published by French and English architectural writers, to have avoided the constant misapprehensions and inadequate or incorrect ideas which we usually meet with in their treatises on this part of the subject. The writer of this book regards the Gothic style, which he calls "German or Romantic," as derived from the Saracenic, and first practised in Germany, whence it was introduced into France, Italy, and England. We should surmise that he has derived his ideas from the study of a German work on architecture. There are other things of the same kind, some representing views that were once held in this country, but have been long since exploded.

This, however, is not the important part of the book, the bulk of which is a practical and theoretical treatise on timber construction, in which the subject is very fully and ably treated, and, with the exception of a few details here and there, and the occasional use of technical terms in a sense rather different from that which they bear with us, there is nothing in the book which is not as applicable to English as to American practice. The plans of town houses given in an early part of the book can hardly be recommended, and would be susceptible of much improvement; but these, again, are only incidental. After this we come to the real work of the volume, commencing with a treatise on construction, in which the theory of strains and pressures is fully gone into, and all the necessary mathematical formulæ and tables for calculating them under given conditions are set forth. This includes, besides timber, the simpler and more general forms of iron construction, and the framing and putting together of timber, illustrated by diagrams, rather small and rough, but sufficient for the purposes of explanation. We then come to more special divisions of the subject, commencing with "stairs," on the first page of which chapter, by the way, the author has fallen into the old, if excusable, error of recommending stone stairs in important buildings as a "fire-resisting" material. The stone stairs would be cracked as soon as the timber ones were consumed, or sometimes sooner; but, after all, when the fire has once got to a staircase so as to begin to affect its stability, it may be doubted whether the possible use of the stair for egress is any longer in question. The difficulties of handrailing, now becoming nearly obsolete through the gradual disuse of the wreathed handrail in this country, are pretty fully gone into and illustrated. The subject of mouldings is pretty fully treated, but the mouldings shown are only very well-worn forms, for the true and scientific cutting of which, however, somewhat elaborate rules are given,—making the matter, in fact, a rather more serious one than it need be. The design for a door for the best room of a house, with suitable "trimmings," is, however, very bad and tawdry; so are the designs for cornices; in fact, as in so many American architectural works, the practical part is all good, and the artistic part, what little there is of it, all bad. Chapters on geometry, arithmetic, algebra, and trigonometry follow; and a long chapter, very fully illustrated, on practical geometry, including the methods of finding the precise shadow cast by objects of specified form upon vertical, sloping, or curved surfaces,—a branch of study which is chiefly useful as teaching the young draughtsman to think about the meaning and laws of his shadows: to propose habitually to apply these geometrical methods in the actual delineation of shadows on a drawing would be mere pedantry.

In the appendix are added a good many useful tables of weights of materials, and other data. The book is very conveniently arranged and printed, with the heading indicating the subject of each paragraph given in thick black letters so as to catch the eye easily in turning over the pages, and there is a very full index. While, however, commending the work as good in itself, and applicable to the wants of the English as well as of the American reader, we must not be supposed to imply that it equals the best known English treatises on carpentry and construction, some of which can now be had in a comparatively cheap form; even leaving out of question the more elaborate treatises on special points which we have. Our old friend Gwilt,—the last edition, at all events,—contains all that is in this book, and a great deal besides.

Miscellanea.

The Gilfillan Monument, Dundee.—Shortly after the death of the Rev. George Gilfillan, the School Wynd congregation, to whom he had long ministered, resolved to erect a monument over his last resting-place in Balgay Cemetery. A number of architects and "ornamental sculptors" (we quote a local journal) were invited to submit competitive designs, and, out of a considerable number received, the one lodged by Mr. David Maclaren, the School Board architect, was unanimously chosen by the committee. The monument has now been erected. It is in the form of an obelisk, rises to a height of 24 ft. 6 in., and measures at the base 6 ft. square. The base course is finished with a few bold mouldings, one of which is enriched with a cut design. Over the base is a massive tapered "die" block, weighing 5½ tons; and on one of the sides of this square the following inscription is cut in well-defined Egyptian characters:—

GEORGE GILFILLAN,
CRITIC, POET, AND DIVINE.
Born at Comrie, 30th January, 1813;
Died at Brechin, 13th August, 1878.
42 years Minister of School Wynd U. P. Church, Dundee.
In grateful and loving remembrance, the Congregation have erected this Monument.

The portion of the monument immediately over this consists of a bold hollow plinth springing from the "die," and on each of the four sides of which is placed a garland of laurel-leaves formed of bronze. Above this a flat plinth is introduced, with mouldings above and below, and having twelve small circular panels cut in the face, into which polished half-balls of red granite have been inserted. From this point starts the tapering shaft of the obelisk, which rises to a height of 13 ft., and is divided into three divisions by triangular channels, thus breaking the monotony of the long plain surface. The whole structure is of grey granite, from Rubislaw Quarry, Aberdeen, and is finished in what is known technically as "axed" work, the only portion polished being the block on which the inscription is cut. Messrs. Sturrock & Sheriff were the contractors for the erection of the monument.

Royal Italian Opera.—The advent of Madame Albani has been attended with brilliant success, and this admirable singer and actress has already on more than one occasion created an effect scarcely paralleled by any of her efforts in previous seasons. As *Gilda*, in "Rigoletto," for example, a few nights ago, Madame Albani both acted and sang with wonderful distinction, and fairly carried away the house. "Il Re di Lahore," with its remarkable *mise-en-scène*, has been effectively produced, with Mdlle. Turolla and Sig. Gayarre in the principal parts, and on Thursday last the revival of "Le Prophète" enabled Madame Scalchi to distinguish herself as *Fides*. To our minds, this lady is the best representant of the part since Viardot Garcia.

Wages in Birmingham.—In November last the Master Builders' Association gave their workmen notice of a reduction of a penny per hour from the 1st of April, 1880. The men on their side gave counter notices. As no agreement could be come to, it was decided to submit the case to the arbitrament of the mayor, Mr. Richard Chamberlain. The masons were not represented, but agreed to accept the same change, if any, made in the other trades. The award is that a reduction of one halfpenny per hour be made up to July 1st, 1880, after which time the reduction is to be three farthings per hour for all trades, and one penny per hour for the labourers.

A Plea for the Extension of Useful Knowledge.—Readers of the papers will have seen lately several very interesting letters, from the pens of eminent men of science, on the scourge known as "the fluke" in sheep. Mr. Buckmaster, in the course of a recent lecture to the farmers of Grantham on the subject, said:—

"Here you have a living thing the shape of a sole, about ½ in. in length, of a dark brown colour, apparently without nerves, legs, eyes, or sex. This thing finds its way through the stomach, and fastens itself by a sucker in the liver of a sheep. Here it lays eggs, some say 2,000 or 3,000, others 40,000. These eggs pass out of the body, and are distributed over the land; but hens' eggs scattered over the fields would never become chickens; nor can these eggs become 'flukes' without the favourable conditions of moisture and warmth. The egg bursts, and the embryo of the future "fluke" floats or swims about. In passing through other changes,—some say four, others six,—it becomes what is called an *encysted cercaria*. It is now taken with the food into the stomach, and developes into a perfect 'fluke' in the liver, where it lays eggs, which pass through the same round of development. It is said that if taken into the stomach in any intermediate condition between the egg and the *encysted cercaria*, it never developes into a 'fluke'; others have stated that it can be developed direct from the egg. Would it not be a good thing to study out the natural history of the 'fluke,' and instead of a picture in a village school of men in a fiery furnace, could we not have good diagrams of the transformations of the 'fluke,' the wire-worm, the turnip-fly, and other things which try the patience and temper of a farmer?"

Locks and Fastenings.—What is more annoying than to have the knob come off? A new patent for locks and door-furniture, called the "Binate," is novel and effective for the avoidance of this. Instead of the knobs being made separate and attached to a spindle, as is usually done, they are here made in one piece without a spindle. The portion which is within the thickness of the door having a diameter as large as the knobs, and being provided with a sunk groove round its circumference midway between the two knobs. A hole, in which the knobs work, is bored in the door, passing through the mortise for the lock. When the lock is inserted portions of it enter the groove in the knobs, and secure them in position. Anything more simple and secure it would be difficult to imagine. Certainly where these are used there can be no more complaints of handles coming off or getting loose,—it is simply impossible. The appearance, too, is neat, whilst the absence of complicated parts must ensure great durability. Messrs. Archibald Smith & Stevens, of Leicester-square, London, are the sole manufacturers. This same firm have made considerable improvements in their well-known excellent door-spring. If the door fall forward, with the new spring it can now be brought up again; and if, when fixed, it is found that the door does not close quite square, the means of rectifying it are afforded.

A Big Ship from the Tyne.—On Saturday last Messrs. Wigham Richardson & Co., Neptune Shipyard, Low Walker, launched a magnificent vessel from their yard. The ship is intended for the Compagnie Générale Transatlantique of Paris, and was named *Villa d'Oran*. She is one of the thirteen to be built in this country for the same owners, Messrs. Richardson having another of exactly the same size and dimensions well forward on the stocks at present. Her dimensions are 320 ft. long, 33 ft. 6 in. breadth, and 25 ft. 3 in. depth. Her tonnage will exceed 2,000 tons, and her engine-power will be capable of working up to 2,000 horse power, and with such engines it is expected that she will make, when fully laden, fourteen knots an hour. The *Villa d'Oran* will trade between Marseilles and Algiers, and will carry the postal service between the two countries.

The Tower of London.—On Saturday afternoon an open-air meeting was held on Tower-hill "to protest against the restrictions placed upon the public in regard to the viewing of the Tower of London and its interesting relics therein collected." Mr. Cox moved, "That this meeting is of opinion that the free opening of the Tower of London without useless restrictions and red-tapeism is highly desirable and absolutely necessary, as the venerable fabric contains a million histories which can alone be properly studied and learnt and converted to public benefit by placing the building and its contents on the same footing as the British Museum, National Gallery, and other national collections." Mr. Harmer seconded the resolution, which was carried unanimously.

Surveyorship Items.—The vestry of Chelsea have increased the salary of their surveyor (Mr. G. H. Stayton, Assoc.-M. Inst. C.E.), 100*l.*, making it 675*l.* in all, out of which he has to provide some office assistance.

Papers at the Institution of Civil Engineers.—The Council of this Society have arranged a final series of meetings of the students for the present session, to be held on the under-mentioned dates, at seven p.m., for reading and discussing the following papers:—

April 23rd. — "Dredging Appliances," by Lindsay Burnet, student; Sir John Coode, member of the council, will preside.

April 30th.—"Description of a Light Draught Steel Paddle Steamer," by John Augustus Thompson, student; Mr. E. A. Cowper, member of the council, will preside.

May 7th.—"Calais Harbour Improvements," by Hans Ditler Fabricius, student; Mr. Abernethy, vice-president, will preside.

The Council have accepted, on behalf of the students, an invitation from Mr. Geo. Livesey, C.E., to inspect the South Metropolitan Gas Company's Works, where a large gasholder tank is in course of construction.

Proposed Completion of Blackfriars Bridge.—The *City Press* says that Mr. Edward Hart has a motion to lay before the Court of Common Council respecting the completion of Blackfriars Bridge. It is well known that ample means, now lying ready, have been provided for perfecting the structure and its accessories. Mr. Hart's desire is that Blackfriars Bridge be completed in accordance with the designs and provisions of the engineer, which would include the addition of appropriate groups of statuary to be placed upon the pedestals provided for that purpose at the extremities of the bridge. He would have it referred to the Bridge House Estates Committee to obtain (by public competition) designs, which shall be the absolute property of the Corporation, at an expense, by way of premiums, of a sum not exceeding 1,000*l*.

Use of Poisonous Colours.—The Council of the Society of Arts, having had their attention directed to numerous cases of reputed poisoning by arsenical wall-papers, and other articles in general household use, have appointed a committee to inquire into the practicability of preventing the employment of arsenic in any processes by which it is allowed to remain in finished goods, and to obtain evidence as to the effect a total prohibition of the use of such processes, or the prohibition of the sale of articles produced thereby, would have upon various trades. To promote the object in view, this Committee has issued a circular to manufacturers of colours, dyers, and others using colours in manufacturing processes, asking for information on certain specific points.

Crystal Palace School of Practical Engineering.—On Saturday the annual meeting for the presentation of prizes and awards of certificates to the most proficient pupils of the Crystal Palace Company's School of Practical Engineering took place in the lecture-room of the southern tower of the palace. Professor James Stuart, M.A., of the University of Cambridge, occupied the chair, and there was a large company assembled, including several engineers and men of eminence. Mr. J. W. Wilson, of the Institution of Civil Engineers, the principal, presented the reports of the examiners, Mr. J. Emerson Dowson, A.-M. Inst. C.E., and Mr. James N. Shoolbred, M. Inst. C.E.

The Telephone.—The Edison telephone is in full operation in Paris, the exchange there numbering over 350 subscribers. The carbon transmitter and Phelps receiver are employed. The lines are under the management of the State, and a closed circuit is employed, in order to avoid induction currents. Experiments up to distances of 140 miles have been made with success. Trial of the telephone is also being made at the Carberry Mine, near Inverask, in Scotland.—*The Electrician.*

St. Enoch Station and Hotel, Glasgow. We understand that we have given Mr. Thomas Willson rather too much prominence in styling him, without qualification, the architect of the hotel. The responsibility of carrying out both the station and the hotel rested with Mr. John Fowler and Mr. Blair (the engineers), up to the time of the latter gentleman's death, in 1876, and afterwards with Mr. Fowler and Mr. Crouch, who succeeded Mr. Blair, Mr. Willson having executed the architectural portion of the work.

Baptistery at Ravenna.—Mr. Henry Wallis writes to draw attention to the bad state of this interesting structure, and the sort of work contemplated there.

Municipal Engineers.—We are informed that the annual meeting of the Association of Municipal Engineers will be held at Leeds on the 27th, 28th, and 29th of May next.

TENDERS

For the erection of schools and residence in Heath-road, for the Harborne School Board (including 100*l*. for desks). Messrs. J. P. Sharp & Co., architects. Quantities supplied:—

Smith & Son	£4,775 0 0
Whitehouse & Jones	4,755 5 0
H. Smith	4,745 0 0
Newey	4,698 0 0
Wilson & Son	4,690 0 0
Bowen	4,673 0 0
Corbett	4,434 17 0
Stockton & Son	4,384 0 0
W. Whitehouse	4,380 0 0
Briley	4,365 0 0
Bennett	4,346 0 0
Sapcote & Son	4,194 0 0
Jeffery & Son	4,172 0 0
Brookes	4,000 0 0
Garlick	4,000 0 0
Harley & Son*	4,000 0 0

* Accepted, being rate-payers in the district.

For rebuilding the Old George, Bethnal Green-road, for Mr. A. Buckley. Mr. Edward Brown, architect:—

Salt	£4,610 0 0
Linsell	4,590 0 0
Shurmur	4,437 0 0
Hughes	4,417 0 0
Good	4,200 0 0
Hearle & Son	4,193 0 0
Outhwaite & Son	4,053 0 0
Marr (accepted)	3,895 0 0
Uff (too late)	3,690 0 0

For the erection of a new theatre in Beaufort-buildings, Strand, London. Mr. Walter Emden, architect. Quantities by Messrs. Evans & Deacon:—

Colls	£20,580 0 0
Patman & Fotheringham	19,164 0 0
Shaw	19,095 0 0
Kirk & Randall	19,000 0 0
Macey	18,890 0 0
Braid & Co.	18,550 0 0

For the erection of new Sunday School, Trinity Congregational Church, Peterborough. Mr. Hampden W. Pratt, architect. Quantities by Messrs. Evans & Deacon:—

Machin	£1,455 10 0
Spriggs & Sutton	1,395 0 0
Hicks	1,289 0 0
Barnsdale	1,268 10 0
Jellings	1,194 0 0
Gray Bros. (accepted)	1,153 13 0
Smith	1,074 0 0

For building house at Penge, for Mr. Goldsmith. Messrs. Perry & Reed, architects. Quantities supplied:—

Clarke & Bracey	£2,697 0 0
Clemence	2,595 0 0
Adcock	2,564 0 0
Jerrard (Croydon)	2,459 0 0
Vaughan	2,397 0 0
Jerrard (Lewisham)	2,343 0 0

For alterations and additions to Werndee Hall, South Norwood, for Mrs. Miller. Mr. Edward W. Stephens, architect, Maidstone:—

Jarrett, Croydon	£4,390 0 0
Legg, Croydon	4,282 0 0
Pearson & Myles, Croydon	4,219 16 2
Wallis & Clements, Maidstone	4,089 0 0
Smith, South Norwood	4,042 10 0
Avard, Maidstone	4,032 0 0
Hobbs, Croydon (accepted)	4,029 5 11

For additions to schoolroom at Gipsy Hill. Mr. Ernest Turner, architect:—

Jenkin	£1,480 0 0
Tyerman	1,460 0 0
Hitchcock	1,443 6 0
Bowyer (accepted)	1,430 0 0

For new dissecting-room, lecture theatre, &c., at St. Bartholomew's Hospital. Messrs. I'Anson & Son, architects. Quantities by Messrs. Linsdell & Giffard and D. Campbell:—

		Extra*	Extra†	Less‡
Colls & Sons	£18,945	£460	£450	
Ashby & Horner*	18,719	425	430	410
Patman & Fotheringham	18,885	435	300	450
Lucas Bros.	18,530	456	415	410
Nightingale	18,395	476	419	395
McLachlan & Sons	18,278	465	285	513
Rider & Son	17,988	437	378	523
Pritchard	17,977	386	375	583
Adamson & Sons	17,960	461	353	433
Trollope & Sons	17,943	450	432	490
Brass	17,783	460	379	435
Ashby Bros.	17,636	542	254	437
Peto Bros.	17,222	266	309	513
Longmire & Burge	17,093	520	380	490
Hill & Higgs	16,980	450	310	340
Macey	16,645	484	246	478
Shaw	15,724	477	230	374

* Add for white glazed brick facings.
† Add for wainscot bookboards, &c.
‡ Deduct for brick front in lieu of stone.

For new shops, Mare-street, Hackney, for Messrs. Abbott & Fletcher. Mr. Chas. Dunch, architect. Quantities by Messrs. Osborne & Russell:—

Taylor & Parfitt	£4,357 0 0
McLachlan & Sons	4,338 0 0
Brass	4,223 0 0
Colls & Sons	4,120 0 0
Macey	4,064 0 0
Morter	3,943 0 0
Boden	3,900 0 0
Sabey	3,898 0 0
Johnson	3,799 0 0
Shurmur (accepted)	3,788 0 0

For erecting four houses and premises in Spicer-street, Spitalfields, for Mr. John Ellerm. Mr. Edward Brown, architect:—

Marr	£2,511 0 0
Good	2,330 0 0
Christopher	2,250 0 0
Salt	2,180 0 0
Shurmur	2,142 0 0
Uff (accepted)	1,980 0 0

For making new road, Kennington, for Mr. Philip E. Sewell:—

Harris	£700 0 0
Porter	675 0 0

For detached stables, &c., Queen Anne House, Woodchurch-road, for Mr. Thomas Yeo. Mr. Banister Fletcher, architect:—

Wagner	£690 0 0
Burman	605 0 0
McCowan (accepted)	560 0 0

For detached residence, Priory-road, for Mr. Powell Warner. Mr. Banister Fletcher, architect:—

McCowan (accepted)	£1,630 0 0

For decorations and repairs at Flintfield House, Caterham, Surrey:—

Langmead & Way (accepted).

For new cottage hospital, Hounslow, for the Committee of the cottage hospital and dispensary. Mr. C. M. H. Crawshay, architect. Quantities by Mr. C. G. Mayland:—

Squelch	£2,700 10 0
Sheppherd	2,695 0 0
Cole	2,300 0 0
House	2,195 0 0
Crasks	2,168 0 0
Langmead & Way	2,129 0 0
Brown	2,120 0 0
Gammage	1,999 0 0
Rumsden	1,995 0 0
Hiscock	1,950 0 0
Greenwell	1,943 0 0
Harris	1,943 0 0
Beecham	1,879 0 0

For Cowley-road Congregational Chapel, &c., Oxford. Mr. John Sulman, architect:—

Holland	£5,950 6 8
Castle	5,443 0 0
Jones & Co.	5,340 0 0
Kingerlee	5,247 0 0
Franklin	4,873 0 0
Jones	4,875 0 0
Stephens & Bastow	4,757 0 0
Jones	4,556 0 0
Ireson	3,963 0 0

For a Board School in Osbourne-road, South Acton, for the Acton School Board. Mr. E. Monson, jun., architect. Quantities supplied:—

Crabb	£3,000 0 0
Veare & Co.	2,997 0 0
Frost & Co.	2,968 0 0
Hunt	2,837 0 0
Crasks	2,698 0 0
Sim	2,641 0 0
Kingerlee	2,643 0 0
Maton	2,610 0 0
Jones & Co.	2,575 0 0
Wall	2,559 0 0
Brunsden	2,550 0 0
Angood	2,520 0 0
Cardus (accepted)	2,450 0 0
Beach	2,425 0 0
Haynes	2,349 0 0

For alterations and additions to St. Paul's Schools, Hounslow Heath, for the Heston School Board. Messrs. Arding, Bond, & Buzzard, architects. Quantities supplied:—

Hiscock	3,599 0 0
Laurence	3,048 0 0
Carless	2,964 0 0
Daniels	2,868 0 0
Brunsden	2,650 0 0
Gammage (accepted)	2,537 0 0
Barnes	2,507 0 0

For stabling and alterations to house, Lake View, Wimbledon, for Mr. Arthur Pollock. Mr. H. A. Alexander, architect. Quantities by Mr. Sidney Young:—

Cox	£2,853 0 0
Outhwaite & Son	2,640 0 0
Harmer	2,485 0 0
Messom	2,471 0 0
Burman	2,430 0 0

For the erection of twelve cottages, Silvertown, E., for Mr. J. J. Smith. Mr. J. T. Newman, architect:—

Abrahams, Poplar	£3,786 0 0
Stimpson & Son, Chelsea	3,224 0 0
Hearle & Son, St. George's, E.	2,873 0 0
Perry, Custom House	2,640 0 0
Reed, Stratford	2,380 0 0
North Bros., Stratford (accepted)	2,350 0 0

For the repair, re-painting, &c., of the High-street Schools, Stratford, for the West Ham School Board. Mr. J. T. Newman, architect:—

Reed, Stratford	£275 0 0
Gentry, Stratford	255 0 0
Morter, Stratford	230 0 0
Hoskings, Stratford	217 0 0
Abrahams, Poplar	206 0 0

For two shop-fronts and repairs to Nos. 5 and 7 Cheshire-street, Bethnal Green, for Mrs. Marchant. Mr. W. Brett, architect:—

Harris (accepted)	£250 0 0

For the erection of eleven dwellings and a recreation hall for the employés of the Royal Windsor Tapestry Works. Mr. P. J. Byrne, architect, Windsor. Quantities supplied:—

Potbury, Old Windsor	£4,695 0 0
Watson, Ascot	4,424 0 0
Woodbridge, Maidenhead	4,079 0 0
Oades & Son, Egham	3,839 0 0

For alterations and additions to Horton Mount, Esher, for H.R.H. Prince Leopold, K.G. Mr. P. J. Byrne, architect. Quantities supplied:—

Garrod & Pratt,* Esher	£684 0 0

* Accepted, subject to revision.

For new stabling and repairs, at Meadowscroft, Winkfield, for Mr. C. Palmer. Mr. P. J. Byrne, architect. Quantities supplied:—

Watson, Ascot (accepted)	£569 0 0

For building a residence at Wimbledon, for Mr. H. W. Lawrence. Mr. F. C. Penrose, architect. Quantities by Messrs. Goodchild & Son:—

Townsend	£2,643	0	0
Gibbons	2,617	0	0
Marriage	2,480	0	0
Clemence	2,477	0	0
Adamson	2,454	0	0
Higgs & Hill	2,353	0	0

For terra-cotta bay-window, &c., to dining-room, Woodlands Vale, Ryde, Isle of Wight, for Major General the Honourable Somerset J. G. Calthorpe. Messrs. Tarring & Wilkinson, architects:—

Perry & Co., London	£489	0	0

For the erection of water-tower and engine-house (exclusive of engines) at Coppins, Iver, Bucks, for Mr. J. E. Taylor. Messrs. Tarring & Wilkinson, architects:—

Passnidge & Sons, Uxbridge	£469	0	0

For pair of labourers' cottages at Chipley Abbey Farm, Suffolk, on the Thurlow and Hundon Estate, for the Right Hon. W. H. Smith, M.P. Messrs. Sedgwick, Son, & Weall, architects:—

Parker, Wickham Brook (accepted)	£300	0	0

For repairs, alterations, and additions to Hundon Hall, Suffolk, for the Right Hon. W. H. Smith, M.P. Messrs. Sedgwick, Son, & Weall, architects:—

Mason & Son, Haverhill (accepted)	£814	5	0

For new entrance-lodge and pair of cottages at same place:—

Mason & Son, Haverhill (accepted)	£505	0	0

For drainage works to new roads, Hemel Hempstead, for Mr. S. Godwin. Messrs. Sedgwick, Son, & Weall, surveyors:—

J. Sear, Hempstead	£497	0	0
Pratt, Watford	474	0	0
W. Sear, Hempstead	470	0	0
Miskin, St. Albans	458	0	0
Turner, Watford	453	4	0
Andrews & Sons, Watford	445	0	0
Clifford & Gough, Watford	395	15	0
Capper, St. Albans (accepted)	385	10	0

For alterations and additions to two houses and shops in Green-street, Bethnal Green, for Mr. J. Orlopp. Mr. H. F. Simmonds, architect:—

Wheeler, Cambridge Heath	£257	15	0
Coles, Old Ford	246	10	0
Edwards, Cambridge Heath	235	0	0
Hughes, Old Ford	229	10	0

For bakery fittings at the Asylum for Imbeciles, Darenth, Kent, for the Managers of the Metropolitan Asylum District. Messrs. A. & C. Harston, architects:—

Smith & Son (accepted)	£675	0	0

For the following fittings at the village home, Banstead, Surrey, for the Managers of the Kensington and Chelsea School District. Messrs. A. & C. Harston, architects:—

Bakery Fittings.

Smith & Son (accepted)	£386	0	0

Chapel Fittings.

Crockett (accepted)	£317	0	0

For alterations and additions to the Infirmary laundry, for the guardians of St. Luke's, Chelsea. Messrs. A. & C. Harston, architects:—

Shapley	£3,770	0	0
Thorn	3,645	0	0
Crockett	3,592	0	0
Linzell	3,586	0	0
Williams	3,535	0	0
Langmead & Way	3,426	0	0
Braid & Co.	3,395	0	0
Craske	3,360	0	0
Wilson & Exton	3,343	0	0
Wilkins	3,296	0	0
Judd	3,197	0	0
Wall (accepted)	3,060	0	0

For cleansing, distempering, &c., at the Poplar and Stepney Sick Asylum, for the Managers. Messrs. A. & C. Harston, architects:—

Shepherd, jun.	£480	0	0
Wright	350	0	0
Derby	259	0	0
Wythe (accepted)	250	0	0

For the erection of a brewery at Cheam, Surrey, for Mr. S. C. Wilde. Messrs. Taylor & Locke, architects:—

Humphris	£560	0	0
Potter	525	0	0
Bassett & Sons	505	0	0

For six shops and dwelling-houses, Bridge-street, Southampton, for Mr. Henry Welsh. Mr. James Lemon, architect. Quantities by Mr. Geo. A. Smith:—

Laver	£3,490	0	0
Bull & Sons	3,400	0	0
Sanders	3,370	0	0
Stevens & Son	3,296	0	0
Crook	3,279	0	0
Rowland (accepted)	2,960	0	0

For detached residence, Hendon. Mr. Banister Fletcher, architect:—

Burman	£1,897	0	0
Donne	1,698	0	0
Burch & Moor	1,691	0	0
McCowan	1,595	0	0
Garrud (accepted)	1,531	0	0

For new mission building, Well-street, Hackney. Mr. W. Gillbee Scott, architect:—

Harper	£1,639	0	0
Brass	1,355	0	0
Forrest	1,195	0	0
Kiddle & Son	1,193	0	0
Grover	1,174	0	0
Smith & Son	1,159	0	0
Palmer	1,145	0	0
Haynes	1,110	0	0
Mattock, Brothers	1,097	0	0
Boyce	1,093	0	0

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